SCIENTIFIC AMERICAN

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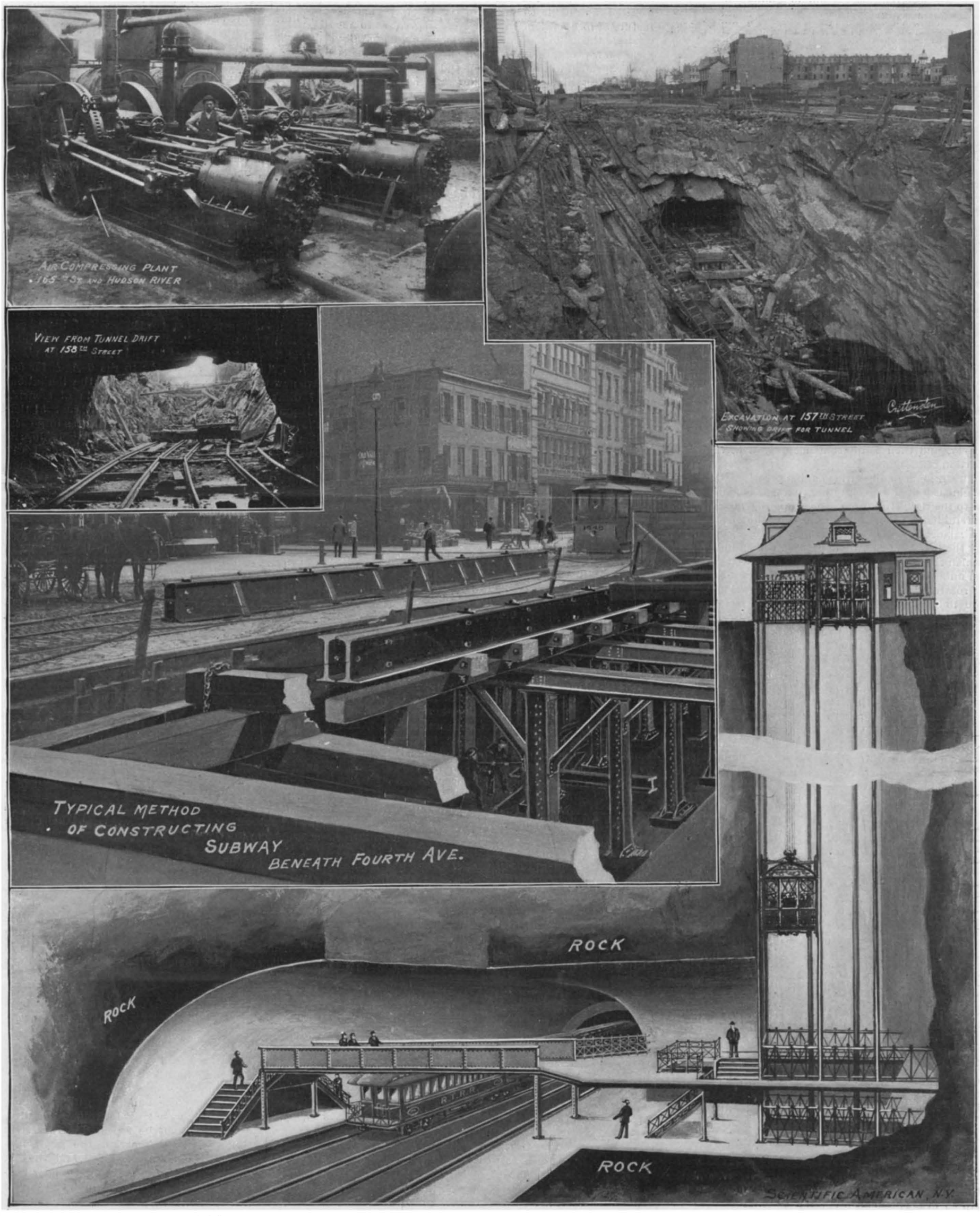
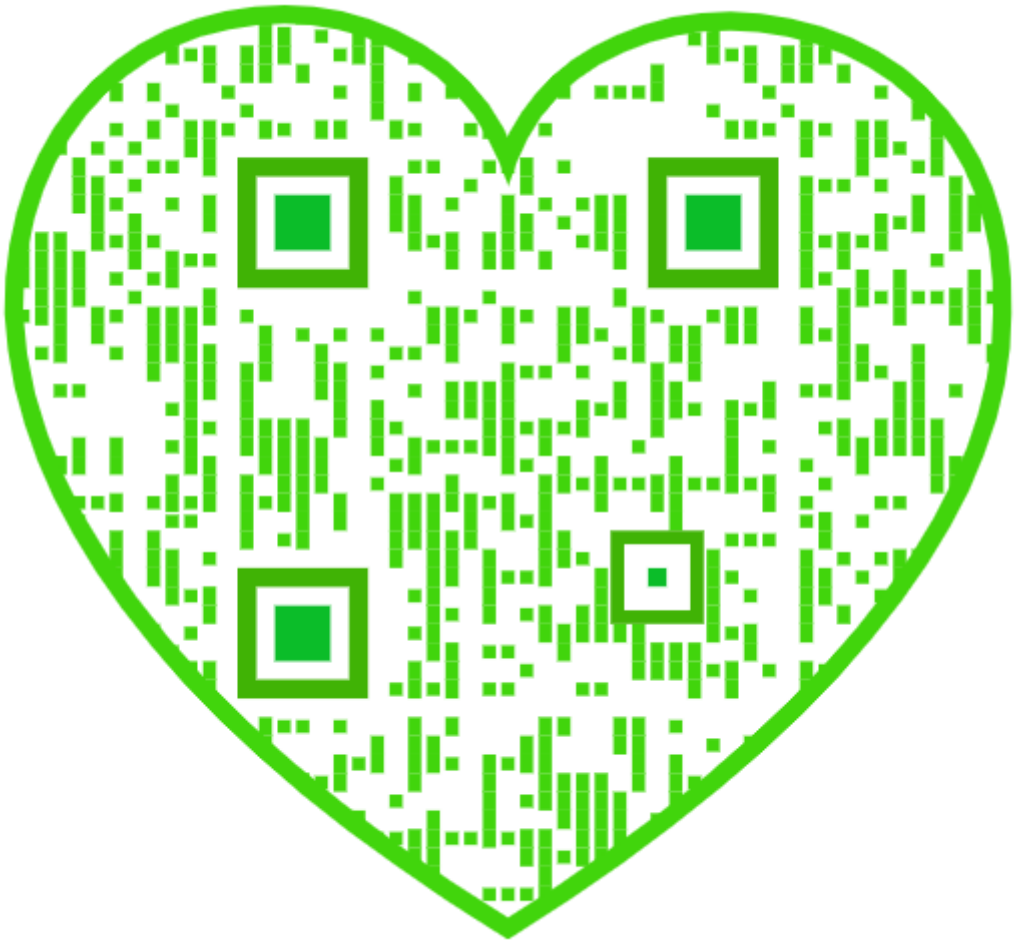


THE UNDERGROUND RAILWAY OF NEW YORK CITY.—[See page 326.]



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OBJECT LESSONS IN CENTRIFUGAL FORCE.

Some years ago, before the railroads had begun to replace the light rails with rails of heavier section, and at the time when the development of the locomotive had reached a point where the concentrated axle loads were greater than the track was well able to carry, it was found that the passage of a train at high speed was liable to produce a serious distortion and permanent set of the rails. In one particular case, after a new and unusually heavy engine, hauling a special train at excessive speed, had passed over a certain stretch of track, it was found that the rails had been bent vertically, the depressions occurring at regular and evenly-spaced intervals. Inquiry into the cause developed the fact that the locomotive carried a large amount of excess balance, that is to say, the reciprocating parts had been so completely counterbalanced that there was a large excess balance in a vertical direction, which resulted, at the high speed at which the train was running, in a vertical hammer-blow, whose downward effect was sufficient to depress the rails beyond their elastic limit, and leave them permanently distorted. The best practice to-day is to reduce the weight of the reciprocating parts to the lowest limit consistent with safety, and then counterbalance only a certain proportion of these weights.

In stationary and marine engine practice, where the engine is bolted directly either to a massive foundation or to the rigid structure of the ship, the necessity for careful balancing is not so pressing, the effect of the unbalanced weights and moving parts being absorbed by the inertia of the whole mass of the foundation of which the engine forms practically a part. So long as an unbalanced engine is controlled within the speed of rotation for which it is designed, no serious effects are to be feared from the unbalanced reciprocating weights; but should a powerful stationary or marine engine get beyond control and run away, it can readily be understood that the tremendous forces developed may reach a point at which the engine will be either ruptured internally or torn from its foundations. An examination of the engine room of the "St. Paul" shows conclusively that it was the effect of the massive unbalanced reciprocating parts, revolving at a speed which is estimated as having been anywhere between 250 and 350 revolutions per minute, that was the immediate cause of the break-up of the engine. Centrifugal forces which are negligible at a speed of 90 revolutions a minute become resistless at three or four times that speed. On the lower half of the revolution the downward hammer-like effect of the unbalanced weights took the form of a blow directly upon the mass of the main bearings, the engine-bed and the heavy cellular structure of the hull; but on the upward half of the revolution, the blow had to be resisted by the caps and holding-down bolts of the main bearings of the crank shaft. The strength of the chain is always the strength of its weakest link, which, in this case, proved to be the threads of the crankshaft bearing bolts, which were entirely stripped, allowing the caps and the crank shafts to be torn loose from the bearings. As there was normally only a slight clearance between the pistons and the cylinder heads, the pistons during the next revolution struck the cylinder heads of the high and low pressure cylinders, knocking them out, and smashing the cylinders themselves.

The rapid increase in rotational speeds which is taking place has concentrated the attention of engine builders, particularly in marine work, upon the question of balancing, and the Yarrow-Schlick-Tweedy system, of which we hear so much in these days, was devised to overcome this difficulty, and seems in the vessels which have adopted it to be a very marked success.

ARMOR CONTROVERSY FINALLY SETTLED.

The Navy Department, the manufacturers, and the country at large are to be congratulated that the miserable armorplate controversy which has been the cause of so much regretable delay in the construction of our new navy, is at last amicably settled. The origin of the trouble was the outcry on the part of a few ill-informed members of Congress that the armorplate manufacturers were realizing excessive profits on their output; and it was due to the general lack of information and intelligent interest in the subject that resolutions were put through Congress reducing the price to be paid for future armor to a figure so low as to be positively ridiculous. The manufacturers claimed, and we think justly so, that the high price demanded for their product was justified at the time by the fact that the first outlay for their plants was enormous; that the returns upon this outlay were primarily dependent upon the caprice of Congress, which might or might not authorize the construction of ships; and also that the risks of manufacture in a process so complicated and liable to mishap as that of the manufacture of face-hardened armor were so great as to necessitate the asking of such prices as would not only yield a fair profit, but also cover, in time, the enormous sums expended in the erection of the plant.

The latest bids put in by the Carnegie and Bethlehem companies have been accepted, the price agreed upon being $420 per ton, the government to assume the liability for royalties to be paid to the Krupp firm for the use of its process of face-hardening. No less than fourteen warships are affected by this contract, the total amount of armor called for being 36,217 tons, and the total cost of the same $16,000,000, including royalties. The first deliveries under this contract will commence in about six months' time, and in the case of the majority of the ships, it is likely that no serious delay will occur. The armor produced under the Krupp process will have a resisting quality, weight for weight, from 20 per cent to 25 per cent greater than Harveyized armor. Our new vessels will thus not only be saved from the stigma of carrying an armor which at the time they are completed would have been fully seven years out of date, but with equal defensive powers they will be ton for ton proportionately far more efficient than if they had carried the now obsolete Harvey armor.

BOGUS PATENT ATTORNEYS IN GREAT BRITAIN.

A recent edition of The London Times contains a statement of the bankruptcy proceedings in the case of a certain Percy R. J. Willis, described as a consulting engineer and draughtsman, of Church Court, Old Jury, London. It seems that "according to the statement of the bankrupt he commenced business in 1890 as a patent expert in partnership with a William Martin, the business being conducted as Martin & Willis, and as the International Patentees' Agency." It seems that "he and his partner also used the name of Donald Cameron in carrying on their so-called patent business," and it transpired under cross-examination that Willis was quite prolific in the use of names, figuring at different times as Sydney Estcourt, the International Patentees' and Finance Company, The Universal Patent Disposal Company, etc. His *modus operandi* was as follows: "The names of inventors in the United States having been ascertained, he sent out to them a number of circulars containing invitations to remit money for the purpose of having provisional patent rights granted to them in Great Britain." He seems to have received "a large number of remittances with instructions to protect the inventions specified. In 553 instances the remittances were not so used, and the statement of affairs which he had filed in his bankruptcy proceedings showed that sums amounting to $11,385 were probably due to inventors in the United States and Canada for money so sent to his firm and absorbed in business expenses."

Percy R. J. Willis is one among an all-too-numerous class of bogus patent attorneys in Great Britain, whose operations have no other object than that of thievery. Unfortunately, at the present time the laws in Great Britain are such that it is open to anyone to style himself a patent agent in that country, since he does not necessarily have to qualify for the position. Hitherto it has been difficult to reach these swindlers, for the reason that the bulk of those who intrust them with money are residents of the United States, and do not care to go to the trouble of prosecuting, or of assisting the Institute of Patent Attorneys of Great Britain in carrying through a prosecution.

There is a movement afoot in Great Britain, just now, to protect inventors from the fraudulent practices of unprincipled patent agents who are not on the registered list of the Comptroller of Patents. At present there are about 250 agents registered by the Patent Office, and their official recognition is a sufficient guarantee of their integrity. Should they be guilty of any misdemeanor, their names are immediately erased from the register. The object of the movement now in progress for the protection both of the inventor and the reputable patent agent is to give the Comptroller authority to prevent any one acting in the capacity of a patent agent, unless he is satisfied as to the agent's probity. The problem has been up for discussion on several previous occasions, and it seems that even Lord Herschel's committee was unable to suggest any practical method for efficaciously stamping out the abuse. The scheme referred to is receiving the hearty support of the registered patent agents in Great Britain, who are naturally desirous of protecting their own reputation. An English correspondent says: "The matter can be greatly assisted by American inventors if they are careful to intrust the securing of British patents only to responsible agents in this country."

THE ANNUAL MEETING OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

The annual meeting of the Society of Naval Architects and Marine Engineers was held last week at the Engineers' Club, 12 West 31st Street, in this city, under the presidency of Mr. Clement A. Griscom. In his opening address the President referred to the present year as having been the most prosperous in shipbuilding in the United States since the outbreak of the Civil War, and he expressed his conviction that the coming century would witness a development which would be fully equal to the high hopes of the members of the Society when it was founded. During the fiscal year which ended in June last, eighty steel steam vessels of 168,000 gross tons were built in the United States. The significance of these figures was best understood by a comparison with the record of the previous nine years, during which the United States built only 575,000 gross tons of the same types of vessels. All the shipyards have been busy, every large plant has increased its capacity, and several new yards have been established and equipped for the construction of the latest merchant and war vessels. The president was followed by Charles H. Cramp, of Philadelphia, who read a paper on the performance of the Russian cruiser "Variag." The excellence of design and construction was proved, he said, by the fact that over a 10-knot course, with 18,000 indicated horse power, the vessel maintained a speed of 24 knots, while with 16.000 indicated horse power it maintained a speed of 23¼ knots for twelve consecutive hours.

Naval Constructor D. W. Taylor read a valuable paper describing the model basin in use at the Washington Navy Yard. Referring to the designs for our five new battleships, and the fact that the limitations of draft imposed rendered the problem of securing adequate speed proportionately difficult, he said that the navy was to be congratulated that it was in possession of such a thoroughly equipped testing basin, the existence or which was due to the persistent efforts of the Bureau of Construction and Repair. Naval Constructor Woodward described at length the tests of electrical plants on the battleships "Kearsarge" and "Kentucky." It seems that the main turrets were turned from extreme starboard to extreme port in 53·4 seconds, and that the full charge for the 13-inch gun was hoisted and lowered between the handling room and the gun electrically fifty consecutive times at the rate of one round trip per minute. Besides the members present there were a number of foreign guests, including Lieutenant-Commander de Faranand, of the French Navy; Lieutenant-Commander Von Rebeur Paschwitz, of the German Navy; Captain Stchensnovitch, of the Imperial Russian Navy, and others.

In subsequent issues of the SUPPLEMENT we hope to reproduce in full some of the papers.

CLOSE OF THE PARIS EXPOSITION.

The 12th of November, the last day of the Exposition, was marred by a cold drizzling rain, which kept the attendance down. The price of tickets dropped until five could be purchased for one cent, and they were finally given away in considerable numbers. Promptly at midnight the lights were cut off, and a cannon on the first story of the Eiffel Tower announced the formal closing. The event was celebrated in the afternoon in the Chamber of Deputies.

The official statistics show that the Exposition was a success, 50,000,000 persons having passed through its gates, against 25,121,975 persons in 1889. In the latter Exposition British and Belgian visitors headed the list as regards numbers, but this year the Germans came first and the Belgians second. Americans also formed a very noticeable contingent. The record day for attendance in 1900 was 600,000, as against 335,377 in 1889. The total cost of the Exposition just closed was somewhere between $40,000,000 and $60,000,000; the exact amount will not probably be known for some time. It is believed that this enormous sum has been returned indirectly in the increase of the treasury receipts, in the surplus of Parisian octroi duties, in the monuments remaining to the state or the city, and in the quays, bridges, and improved transportation facilities left by the Exposition.

The work of removing the exhibits began at once, and as soon as possible the buildings will be demolished, so the unsightly wreck at Jackson Park after our own fair of 1893 will not be repeated. No vestige of the Exposition will be left except the great hothouses on the north bank of the Seine and the Art Palaces. Many of the buildings, owing to poor construction, were already in bad condition on the day of closing. The nineteenth century has been a century of expositions, ten having been held in the last fifty years.

THE STEAM TURBINE IN LARGE MERCHANT STEAMERS.

BY REAR-ADMIRAL GEORGE W. MELVILLE, ENGINEER-IN-CHIEF UNITED STATES NAVY.

Although I have aimed to be conservative in the following expression of my personal views on the use of the turbine in large merchant steamers, made at the request of the editor of the SCIENTIFIC AMERICAN, I have also sought to be something more than general—to be concrete and specific enough to leave no question of my positive opinion. At the same time, I would wish to preface my comments with this statement: That, generally, I realize the fact that the engineering world must go forward, and that by experiment, by trial and error, we must in part proceed; and, further, that it does not make for progress to throw too much cold water on the experimental and inventive stage of any form of machine, nor to dampen the ardor of the enthusiast, who, by attempting the impossible, often gains something not heretofore attained. On the other hand, we must put a wholesome check on the thousand and one engineering fads and follies of the hour.

Furthermore, I heartily believe in every navy spending a proper amount of money in purely scientific experiment, to say nothing of practical experiments to a limited extent with certain more or less untried types of vessels; and I in no way wish, when commenting herein on the different governments that are installing the turbine in torpedo craft of their navies, to reflect on the policy of any naval power. For nations, to force the lead, have sometimes to take the experimental initiative themselves, even at great risk. Moreover, it ill becomes a progressive nation to sit still and watch other nations experiment, and learn entirely from their failures, without bearing a part of the brunt of them itself.

Every engineer thoroughly appreciates that it is infinitely hard to predict the exact hour when the "tried and true" machine must give way to the actually better appliance.

However, in making the following brief comments I have been guided wholly by actually existing facts, and have tried to remember at all times the relation between theory, experiment and proved practice, as well as to bear in mind the vital principle of distinctiveness or individuality in mechanical appliances, which gives to certain forms of machines a mechanical advantage not to be secured in any other form, whose rejection for another would depend often upon certain conditions of service which give a special relative value to an advantage or disadvantage.

My opinion as the Engineer-in-Chief of the Navy may, or may not, be respected as *ex cathedra* in regard to the steam turbine, as it may be in regard to any other mechanical device coming under the head of correct mechanical engineering. In the first place, it is the privilege, nay the right, of every scientist, physicist, or mechanical engineer to doubt the performance of any machine or contrivance until said apparatus has proved its correctness of design and utility, not only experimentally, but by useful performance of work for long periods of time. There are machine problems presented to the mechanical engineer every day that may appear mathematically and theoretically correct, but which will not stand the test of time. Therefore, beyond the opinion of an expert, trained and scientific engineer, the real test of new machines lies wholly in experiment and experience. I believe that the opinion of the expert, ninety-nine times out of a hundred, is correct, and is proved so when tested by actual experiment.

Now as regards the steam turbine, the question is, Has it gotten beyond the experimental stage? There is not the slightest doubt that it will run, or that it has run to some purpose. But the question is, How well has it run, how economically has it run, or will it run; and to what extent may it take the place of the reciprocating steam engine? The whole engineering world knows how well the turbine, in respect of the speed attained, has performed in the "Turbinia" and in the "Viper;" but the question arises, Are not these merely racing machines? What value have these vessels beyond the fact that they have been propelled by the turbine at a very high rate of speed? The engineering world demands something more in its vessels than mere speed. They must be useful for some specific purpose, and the question may well be asked: Of what value is a vessel that has speed alone?

I do not believe that the turbine has yet proved itself efficient as a marine steam engine. It has done nothing that the reciprocating engine cannot do, and the reciprocating engine for marine purposes can do very readily many things that the turbine cannot so readily do.

I say this advisedly, in the face of the fact that Great Britain, France and Germany, and, I believe, Japan, have entered into contracts for experimental torpedo or other fast craft propelled by turbines. For it will require protracted service, and certainly something more than a fast trial trip, to prove the utility of these craft. As regards its fitness for the merchant marine, turbine vessels should be put in service, and continued in service as wage earners for weeks, months, and years, before we can express an intelligent opinion as to the probability of their supplanting vessels powered with the well-tried reciprocating engine.

Many of the high-speed torpedo boats of the nations of the world—I may say of all powers without exception—make high-speed trial trips, and are then laid up in reserve with a record for speed that is never again attained. In fact, many of them are tied up at navy yards or naval stations and permitted to rust out. In considering the practicability of the turbine for the merchant service, it is evident that no such record and results will be tolerated.

Heretofore, to realize any economy at all, the turbine has been compelled to run at very high velocities, unsuited to the present ideas of the marine screw propeller; and to get around this difficulty, many varying combinations of turbine and propeller have been resorted to. But, were the turbine increased in size, with a view to reducing its speed of revolution to that required in well-designed propellers suitable to the hulls of our ships of to-day, I fear it would be inordinately large in diameter. Therefore, until turbines make a gradual growth from service in the high-speed flier of to-day of little utility to that of the merchantman and the tramp, I do not believe any company would be justified in putting them in any great steamship like one of the great transatlantic liners.

On the other hand, because of its very high speed and reported economy, it seems particularly well suited for electric drive for dynamos, and Mr. George Westinghouse is about to put it to this test; and I doubt not that it will turn out successfully in his hands.

The stationary engineering world will watch this experiment with great interest. If the turbine in such service does not prove economical and durable, it will hasten its doom, for there is nothing that the turbine can do in this service that cannot be done equally well by the reciprocating engine, the conditions being such that the dynamos can be increased to any size to suit the piston speed of the reciprocating engine.

Therefore, in answer to your question, Mr. Editor, I am compelled to say that, for marine purposes, I do not believe that the turbine is to-day in a position to replace the reciprocating engine; and further, that unless it shows greater economy than it has heretofore shown, it cannot replace the reciprocating engine on shore.

The engineering world may be excused for expressing a conservative opinion on this matter, in view of the lack of those definite data as to coal, steam, and water consumption which as yet have not been made known to the public.

NATIONAL ACADEMY OF SCIENCES, PROVIDENCE MEETING.

BY WILLIAM H. HALE.

At the annual meeting, held in Providence, R. I., on November 13, the papers presented included two by Prof. T. W. Richards, in one of which he described a porous cup voltometer which can measure the current absolutely with the same degree of accuracy with which you can measure electro-motive force. In the other he gave an account of the study of growing crystals by instantaneous microphotography. By ingeniously combining camera, microscope and electro-motive force, he finds that the early stages of crystal formation are characterized by extremely rapid growth, so much so that distinct images can only be obtained by exposures of less than one-tenth of a second.

The papers of Dr. Charles S. Minot on development of the pig, the rabbit and the dogfish were further studies in progress of life and the action of vital forces from the embryonic to the senile stage in which he has so long labored, and with notable success in regard to human life.

Prof. A. S. Packard, in his paper on the distribution and phylogeny of Limulus, showed that these land crabs occur in definite areas on the east coasts of both hemispheres; and their descent may be traced from forms in the carboniferous. He also read a paper on male preponderance (androrhopy) in lepidopterous insects.

Prof. A. A. Michelson in two papers described improvements in the echelon spectroscope, and a very interesting analysis of the spectrum of sodium in a magnetic field, which could only have been made by this delicate instrument, because the lines are only $\frac{1}{800}$ of a 10th meter. The discovery by Zeeman that the lines of the spectrum of sodium are broadened when the sodium vapor is within the field of a magnet, he characterized as one of the most interesting of recent times. Michelson soon found that these lines were double; then Zeeman found them to be triple, and Michelson found that they separated farther as the density of the vapor increases; also a central line not previously present appears, which again disappears if the density becomes excessive. When the sodium vapor is very dense, it shows a double line even when not in a magnetic field. The lines specially discussed were the characteristic sodium lines D and D_2. It has been suggested that this is a double line only in appearance; the middle dark portion being an absorption band caused by interference. Prof. Michelson gave several reasons for rejecting this hypothesis, the most cogent of which seems to be that when an elliptical capillary $\frac{1}{10}$ millimeter by $\frac{1}{2}$ millimeter, with pressure of $\frac{1}{1000}$ atmosphere, is used, the absorption is identical when the passage is through in either direction. These studies may throw light on the motions of molecules and their relations to the interstellar ether.

Prof. Alpheus Hyatt, in two papers, gave a most elaborate presentation of his theory of progressive evolution of characters in the young stages of cephalopods, and a descriptive method of presenting the phenomena of the cycle of evolution among the shell-covered cephalopods; so thoroughly worked out and graphically presented that Director Walcott, of the Geological Survey, remarked that he now for the first time really understood this theory, to which he had so often in previous meetings of the Academy heard Prof. Hyatt refer.

Prof. S. L. Penfield, of Yale, read a paper on stereographic projection and some of its possibilities from a graphical standpoint. He found this the most practical method of pictorial representation of crystals; and he considers it eminently useful for maps, being in fact the only system of projection whereby distances can be accurately and instantly measured upon the map. Even a schoolboy can readily use the protractor which Prof. Penfield has invented for this purpose. He illustrated this feature by using before the Academy a roughly graduated protractor, graduated only to five degrees; but even with this most of his measurements were accurate within a few minutes. Thus the distance between New York and New Orleans was given within three or four geographical miles, whereas maps which he had purchased, though much larger, showed errors ranging from six to nearly forty miles. By more finely graduated protractor, he can at once measure all distances within one-fourth or one-half a mile of perfect accuracy.

The principle is that of projecting a vertical arc on the diameter of a circle, as by drawing lines from all parts of the Northern Hemisphere to the South Pole, and using the plane drawn through the equator as a map. This system is, however, amenable to the objection that a protractor is indispensable in judging distances, because the center of the map is much crowded together, and it gradually expands in every direction till distances at the periphery are fully twice as great as at the center, hence the eye is quite misled. In this respect it distorts the inhabited portions of the earth even more than the Mercator projection, which is not seriously out of proportion except in circumpolar regions.

Director Charles D. Walcott, of the United States Geological Survey, has just brought back from eastern California some photographs of specimens showing in small compass good illustrations of the foldings and faultings of the Cordilleran area, which he exhibited and explained to the Academy. The method of formation of these ranges, and the shapes assumed by them, are easily understood from these specimens, which consist of hard and brittle limestones alternating with softer strata, all folded together, and afterward subjected to stress and strain which has rent the hard strata in numerous places, producing faults close together, while the softer intervening strata have followed without cracking. In some instances the fault appears in two parallel hard strata, yet without affecting the ntervening soft rock.

Prof. Carl Barus exhibited several ingenious pieces of apparatus invented by him. His demonstration of the projection of one grating upon another showed interesting optical effects. His wave machine, which has been already described in published articles, was exhibited for the first time. The variety of waves producible is marvelous: progressive, stationary, with stationary or with progressive nodes, reflected as from a dense to a rare medium, or *vice versa*, etc., illustrating sound, light polarization, elasticity, and much more. The recording system of two degrees of freedom ingeniously combines two kinds of movements, that caused by the hairspring of a watch and that caused by gravitation. This is the first time that such a combination has been made; and it was suggested that it might be applied to practical use in ascertaining the gravitational effect of mountain chains, etc., in crossing a continent. The system consists of a watch suspended by its top, and having ballast below it, so that it swings as a pendulum, being capable of vibrations of large or small amplitude, and also of duration regulated by the weight attached. The effect is to make the watch run faster or slower than the normal rate, and many noteworthy results are produced.

The programme also mentioned the tube producing cloudy colored condensations, but as this requires a steam engine to actuate it, it was not shown. Many beautiful effects are produced, similar to sunset colors, and in some respects surpassing them.

After adjournment of the meeting, the members were invited to Ladd Observatory, where the tiny planet Eros was seen, being now in favorable position; also the apparatus for observing the Leonid meteors was inspected.

SWISS TURBINES.

BY FRANK C. PERKINS.

The Swiss turbine has come to be recognized in continental Europe as standard and is found in operation throughout the world. One firm alone in Switzerland has installed more than 3,000 turbines, aggregating more than 300,000 horse power. This firm, Escher, Wyss & Company, has its main works at Zurich, Switzerland, and others at Ravensburg, in Württemberg.

A very interesting turbine exhibit has been made by them at the Paris Exposition, as seen in illustrations, Figs. 1 and 2. The largest turbine shown by them is a 2,500 horse power horizontal Francis double turbine, seen in Fig. 1; this turbine has a diameter of 5·25 feet and operates at a speed of 160 revolutions per minute.

A 600 horse power simple Francis turbine is shown, which will be installed at the Electrical Works of Vezère (Correze) for the Société des Forces. This turbine will have a speed of 300 revolutions per minute under a head of 141·14 feet. The diameter is 3·6 feet and the turbine is equipped with an automatic hydraulic regulator.

The large turbine, dynamo and regulators seen in Fig. 2 are soon to be placed in the power house of the Enterprises des Forces Motrices du Rhone at St. Maurice (Valais) for lighting the village of Lausanne, Switzerland, by electricity. This turbine has an effective capacity of 1,000 horse power under a head of 104 96 to 111·52 feet and operating at a speed of 300 revolutions per minute.

The diameter is 3·28 feet, and the regulation is obtained by the automatic hydraulic regulating apparatus seen in the foreground of the illustration in connection with electrical regulating apparatus of Cie. l'Industrie Electrique of Geneva, Switzerland. The direct current generator, which is connected to the turbine by a flexible coupling, is of the type designed by M. Fleury, the engineer who has introduced so many high tension direct current power transmission plants. This machine is a six-pole continuous current generator, and it will be noticed that the base is especially insulated by being mounted in porcelain supports with iron pins.

Escher, Wyss & Company have recently constructed a vertical centrifugal double turbine for the electrical transmission plant between Chevre and the city of Geneva, Switzerland; the capacity, when used as a summer turbine with low water, is about 900 horse power with a head of 1410·4 feet and a water flow of 5,590 gallons per second. When the turbine operates in winter under high pressure, it has a capacity of 1,200 horse power under a head of 26·5 feet and a flow of water of 4,160 gallons per second, the speed in both cases being 120 revolutions per minute.

A high pressure double turbine with automatic hydraulic regulation has been built by this firm for the electrical plant of the Société Industria Electrica Barcelone. It has a capacity of 550 horse power and operates at a speed of 375 revolutions per minute under a water head of 301·76 feet. The diameter of this turbine is 3·608 feet.

A number of interesting models are exhibited of dynamos of the Compagnie de l'Industrie Electrique, of Geneva, and of Brown, Boveri & Company, of Baden, directly connected to turbines of Escher, Wyss & Company; also numerous turbine and pump models of existing plants in Switzerland.

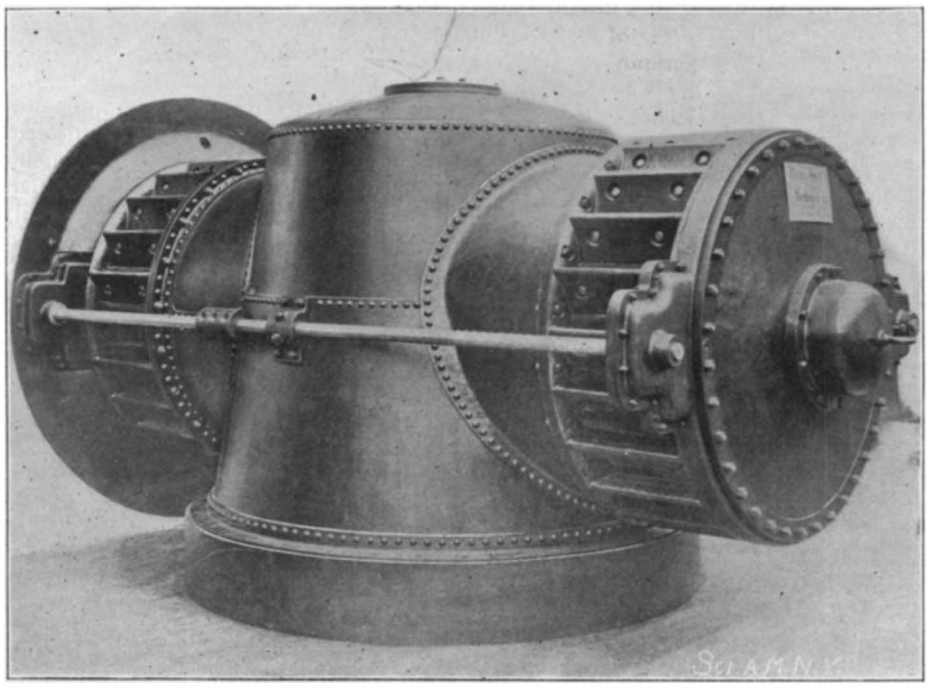


Fig. 1.—FRANCIS TURBINE—PARIS EXPOSITION.

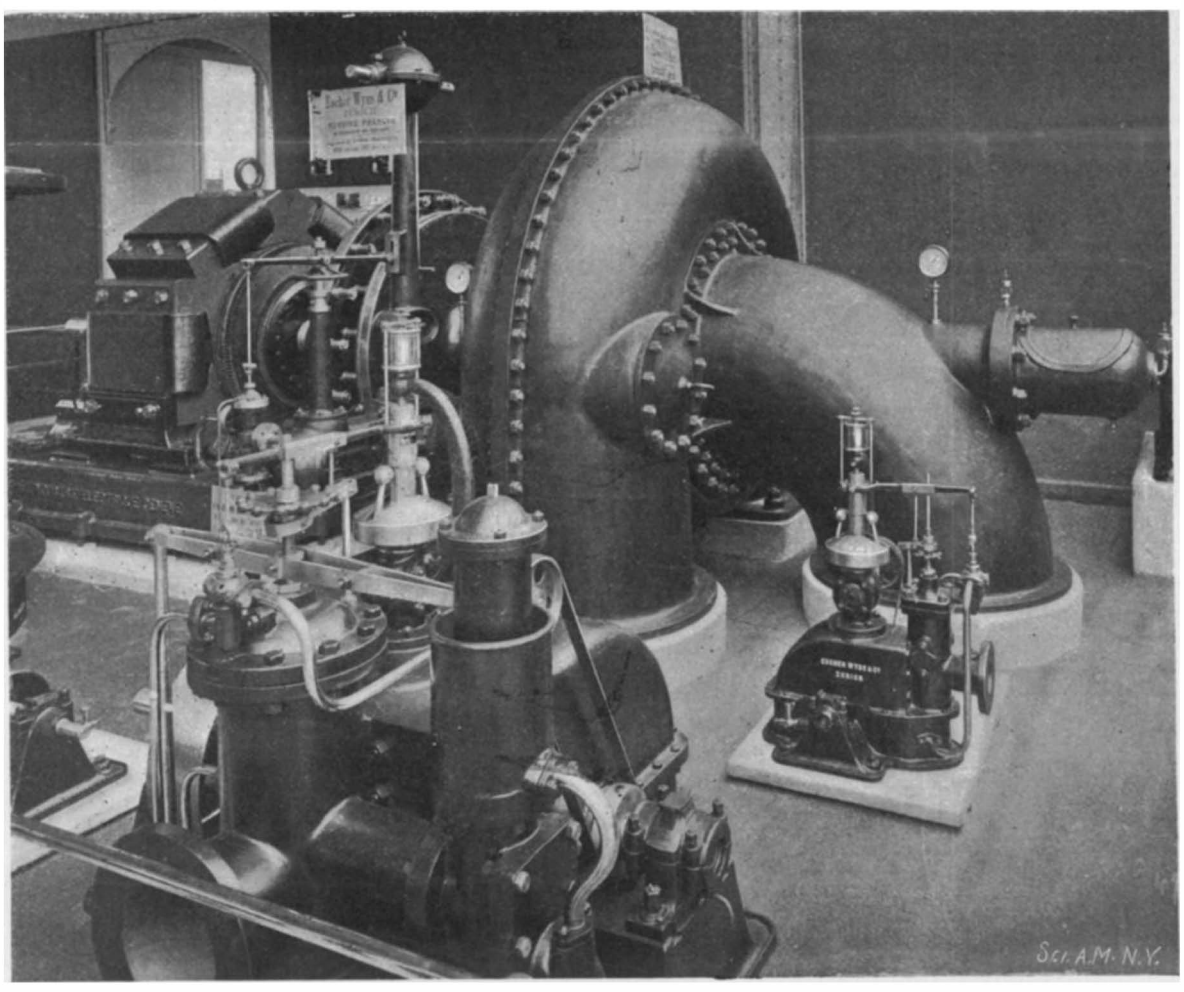


Fig. 2.—DIRECT CONNECTED TURBINES OF ESCHER, WYSS & COMPANY, OF ZURICH.

THE interchangeable system appears to have been invented by Eli Whitney, who in 1798 had a contract from the United States government to supply 10,000 muskets. He was obliged to employ the system by the scarcity of skilled labor.

Electric Printing.

A London photographer, Mr. Friese Greene, has succeeded in producing electrographic paper which promises to revolutionize the "art preservative of all arts." Using the new, patent paper, the Electrical Inkless Printing Syndicate has recently perfected a process of printing without ink. Instead of saturating the paper with the sensitizing materials, as has hitherto been done, it has been found best to mix them with the pulp in the process of manufacture; and so a radical departure has been made and a new machine-made paper has been invented that has rare properties.

As the chemicals used are abundant and cheap, the new medium can be produced as cheaply as common paper. The prepared paper is stable and colorless; is unaffected by any other agent than the electric current; may be kept indefinitely and sent to the press directly from the roll as manufactured, with no preliminary treatment whatever; yields instantly a dense black, permanent print; requires no subsequent "fixing" or developing; indeed, is ready for distribution immediately, as there is nothing like ink to smirch or require drying; in short, meets all the requirements of a perfect medium for electric printing.

Given such a suitable paper, and the mechanical problems incident to a practical system of electric printing are comparatively simple.

The London syndicate, having satisfactorily completed the experimental part of its undertaking, is now engaged in demonstrating the workings of the new process and overcoming the objections of printers.

The machine for electric printing is simply an ordinary press divested of all its inking mechanism and having the cylinder or paper-bearing surface covered with a suitable conducting metal. The work of "make ready" is the same as for ordinary printing; and line blocks, electrotypes, woodcuts, halftones, engravings, all kinds of designs in relief, may be used at will.

The "form" is connected with one pole of the dynamo or battery—for most purposes the current may be taken from an ordinary incandescent light wire; the paper-carrying cylinder or surface is connected with the opposite pole. Thus, the metal surfaces of both cylinders are the electrodes, while the paper is in reality a very thin cell in which the pulp is an inert medium and the contained chemicals are the electrolyte. As the cylinders approach each other to press the paper as it is fed between them, the current is switched on automatically and flows from one cylinder through the paper at the points of contact to the other cylinder, the impression being produced instantly by electrochemical action. A governor, or variable "resist," permits an operator to control the quantity and intensity of the current, which must be continuous. The paper possesses magnetic electric properties, and consequently the amount of current required is surprisingly small. The voltage used may be from 10 to 100, and 4 amperes are ample for the largest machines. All inking mechanism being dispensed with, the power necessary to drive the press is greatly diminished. For a given piece of work the cost of current for the actual printing is said to be only one-half that of ink, while a saving of at least one-third in the original cost of presses is assured.

The new process lends itself readily to all speeds, even to the fastest web presses. At an exhibition at Blackpool, England, witnessed by a large company of printers and scientists, a rotary press was run at the rate of 6,000 impressions per hour, and the work was declared perfect in every particular.

Thus far, the efforts of the syndicate have been almost exclusively given to black print, but incidentally there have been some promising developments in the line of color work.

Relative to the appearance of electric printing, The Journal of Printing and Kindred Industries of the British Empire says it greatly resembles lithographic work. The Inland Printer states that samples furnished that paper "are remarkable in their clearness of outline and solidity of color."

At last accounts several of the great London dailies had placed their plants at the disposal of the syndicate for an exhaustive test of the process.

So far as known there have been no attempts as yet to utilize this electrographic paper for any other purpose than presswork; but evidently its field is far wider than this, and not unlikely it will soon be made use of in other fields of graphic art.

H. B. WREN, M.A.

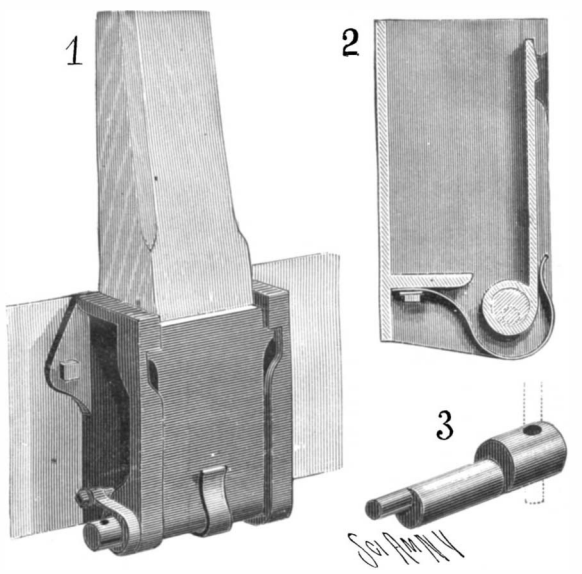
United States Weather Bureau, Washington, D. C.

THE coal-tar derivative fuchsine is generally supposed to owe its name to the fuchsia, as its tint certainly resembles the color of that flower; but this is not the case. The inventor of fuchsine, whose death was lately recorded, M. Francisque Renard, and his brother desired to identify their name with the new product; but, not liking to adopt the appellation of renardine, they translated their family name Renard (fox) into the German Fuchs, and thus arrived at fuchsine, says The Engineer. The same journal seizes the opportunity of making known that the rare metal gallium owes its name to a similar circumstance. Its discovery is due to the French chemist, Lecoq de Boisbaudran, who, by adopting the Latin form of gallium, identifies the name of Lecoq both with gallus, a cock, and Gallia, France.

A HOLDER FOR CAR-PLATFORM STAKES.

An invention has been patented by Mr. James Cowan, of Holualoa, North Kona, Hawaii, which provides an improved stake-holder for railway-car platforms. Fig. 1 is a perspective view of the device; Fig. 2 is a sectional elevation; and Fig. 3 is a detail view of a peculiar operating shaft employed.

The holder comprises a casing having a back wall, side walls, a stop which serves to support the lower end



COWAN'S STAKE-HOLDER.

of a stake, and a swinging front plate. At its lower end this front plate is mounted on an eccentric shaft (shown in detail in Fig. 3) having bearings in the side walls. The shaft has an outward projection formed with an opening into which an operating lever may be thrust, as shown in dotted lines. Lateral projections on the upper end of the front plate are designed to pass through outwardly-opening slots in the front edges of the side plates and to engage in recesses at the upper portion of the slots. A spring is attached to the stop at one end, so that its free end is engaged against the outer surface of the swinging front plate (Figs. 1 and 2). By means of this spring the front plate is automatically swung into position. One of the side plates, as shown in Fig. 1, is provided with a stud to which is attached a spring coiled around and secured to the projected end of the eccentric shaft.

When it is desired to remove a stake, the eccentric shaft is rocked by means of the operating-lever previously referred to, causing the front plate to move downward and outward. The stake may then be removed. When the lever is released, the spring secured to the stop (Fig. 2) will force the front plate against the side walls, and the coiled spring will rotate the eccentric shaft and raise the plate into the recesses of the side walls.

Self-Registering Rain-Gage.

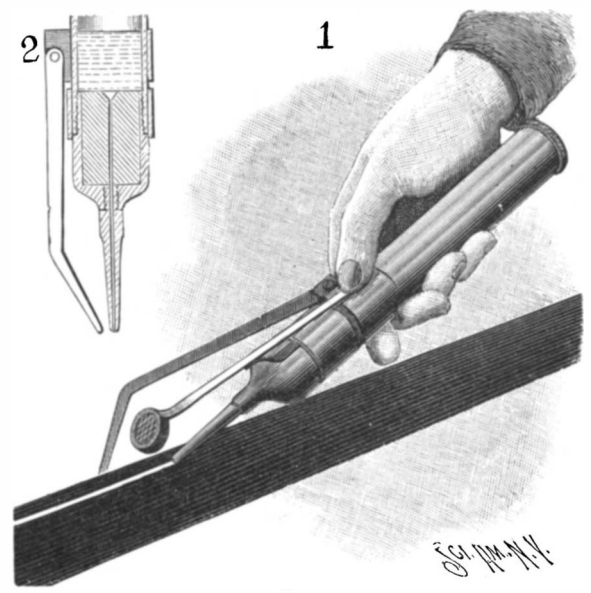
At the recent meeting of the British Association was described a new self-registering rain-gage, the invention of Mr. W. T. E. Binnie. The contrivance resembles the conventional type of rain-gage with the funnel for collecting the rain, but the neck of the funnel is smaller in diameter at the top than at the bottom. By this means the inventor contends he is able to let the rain pass from the receiving funnel into the receptacle below in drops of water of approximate size, owing to the laws of surface tension by which the formation of drops is governed. As each drop falls from the funnel into the vessel beneath, the impact of it makes and breaks the contact of a small electrical machine, which records each drop upon an automatic record, made to revolve upon a drum at a regular set speed.

A PAINT-STRIPER OF IMPROVED FORM.

Our illustration represents a simple device, by means of which painters can readily stripe flat or rounded surfaces. The device is the invention of Mr. George H. Allen, North Creek, N. Y.

The striper consists of a paint reservoir closed at one end by a screw-cap provided with a vent-hole controlled by an adjustable gate. At the other end of the reservoir a nozzle is located. Embracing the reservoir are two clips, the upper of which is made of spring metal and receives between its ends a guide arm bent near its lower end. The second clip serves the purpose of holding a flat spring, upon which a rocking arm is mounted, carrying at its lower end a sealing cup. The flat spring normally presses the sealing cup tightly against the nozzle to prevent the escape of paint from the reservoir.

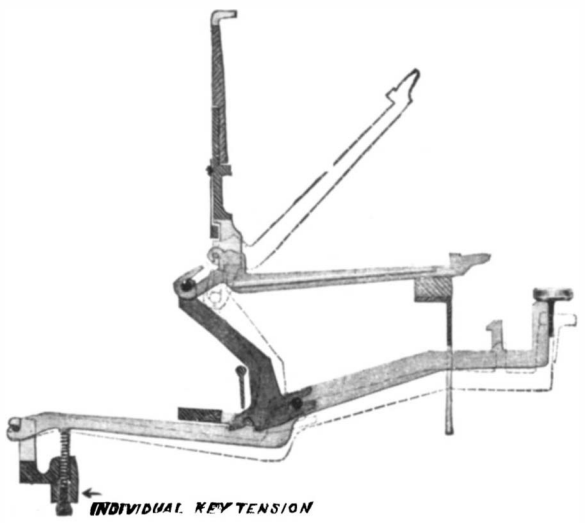
In order to stripe a surface with one or more straight lines, the guide arm carried by the upper clip is adjusted so that its bent end engages the edge of the surface. As the device is drawn along, the nozzle is opened by pressing the end of the rocking arm carried by the lower clip, so as to bring the sealing cup upward. The merits of the device are obvious.



AN IMPROVED PAINT-STRIPER.

THE UNDERWOOD TYPEWRITER.

It is rarely indeed that an American manufacturer contentedly folds his hands and admires his product with that smug complacency which implies that improvement is impossible. On the contrary, there are a thousand and one details to which he devotes the very closest attention and painstaking effort in order that his machine may issue from his factory, if not absolutely perfect, at least as perfect as he can make it. Ruthless competition and the demands of his customers will never permit him to rest. Nowhere in the field of modern industry is this constant improvement



TYPE-BAR MOVEMENT.

in detail more marked than in the manufacture of the typewriter, a machine so distinctly American that foreign makers have not as yet been able successfully to compete with the manufacturers of the United States. As an example of the infinite care and labor which has been lavished upon the writing-machine, we have selected a typewriter called the Underwood made by the Wagner Typewriter Company of 218 and 220 Broadway, Manhattan, New York city.

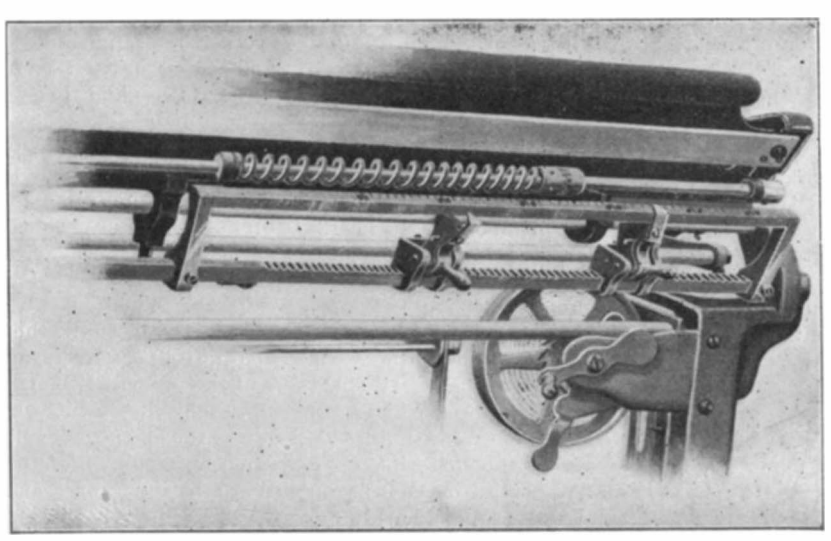
In general design and mode of operation the Underwood machine presents no radical difference from other typewriters. The features of novelty are to be found in an ingenious type-bar mechanism, which is one of the most successful attempts yet made to secure a perfectly even "touch;" in a simple tabulating device which adds much to the convenience of the machine; in a new system of line-spacing; and in an arrangement of platen and type-bars, which at all times enables the operator to see what has been written without lifting the carriage, and which, therefore, materially increases the speed.

In the type-bar mechanism, as may be seen by reference to our illustrations, the key-levers are fulcrumed at the rear of the machine, and are returned to their initial positions by coiled springs. Pins on the key-levers enter the slotted lower ends of bell-crank levers; while pins on the upper ends of the bell-crank levers engage the hooked inner ends of the type-bars. Upon depressing a key the corresponding type-bar is thrown with a constantly accelerating speed against the ribbon. The movement is somewhat similar to that of the hammers of an upright pianoforte, with the difference that the type-bar does not leap back after it has struck the ribbon. The merit of the invention is obvious. The type-bars act directly under the influence of the depressed keys, whereby a rapidity of movement is obtained which will satisfy even the most exacting operator. As in the ordinary form of machine, each key moves the universal bar. In the typewriter under consideration, however, the universal bar is moved only when the type-bar has nearly reached the printing point. Little resistance is, therefore, encountered. Instead of acting against the combined weight and resistance of the type-bar and universal bar, the operator here opposes the resistance and weight of the type-bar alone. Each key has its individual tension. The keys are, therefore, all depressed to the same extent and the same force. The small effort required to overcome the resistance and weight of the type-bar, the uniform key depression, and the individual key tension give to the "touch" a lightness, an evenness, and an elasticity which leave nothing to be desired.

The platen is not fixedly journaled in the carriage, but is independently shiftable by means of two shifting-keys. The one shifting-key is employed for making single capitals; the other for the continuous production of capitals. The two shifting-keys are connected by a rock-shaft. The key for the continuous production of capitals is provided with a pin which can be locked in place by a latch carried on the rock-shaft. The shifting-key is held in depressed position until the other shifting-key is tapped to throw the latch away from the pin.

The ribbon is carried on two horizontally-arranged spools and is made to pass about a guide, which, as a key is depressed, moves vertically on a fork, the forwardly-projecting divergent tines of which receive the type-bars. Perfect alignment is thereby secured. When the platen is shifted up or down, the ribbon-guide, together with the ribbon, is similarly shifted to

THE UNDERWOOD TYPEWRITER.



REAR VIEW OF MACHINE, SHOWING TABULATING SCALE.

keep the ribbon in proper position relatively to the platen or printing line. The arrangement is such that the work is at all times visible. The necessity of lifting the carriage from time to time to inspect the work not only is inconvenient, but so markedly lowers the speed that most manufacturers have found it advisable to provide some means for enabling the operator to see at least part of what has been written. It is one of the most meritorious features of the Underwood typewriter that the work is always entirely in sight.

The feed-dog comprises a fixed tooth and a movable tooth. The feed-rack is normally in engagement with the movable tooth. When a type-bar is launched against the platen, the fixed tooth is brought into engagement with the rack, so that during the printing movement of the type-bar, the rack with the carriage remains stationary, the movable tooth being at the same time free to snap back. On the return of the type-bar, the movable tooth again falls into the rack and enters the next notch. The movement is quick and positive.

The carriage is provided with an index which travels over a scale, and with a shoe which at a certain point of its travel depresses a shoulder connected by levers with a bell-hammer. The shoulder can be moved along the scale so that the written matter will end at the desired distance from the right-hand edge of the paper, and so that the bell will ring at the proper time. A movable stop is provided to limit the return movement of the carriage. Both shoulder and stop are provided with fingers which play along the scale, thereby enabling the operator the right and left travel of the carriage to any degree.

One of the most convenient adjuncts of the machine is a tabulating mechanism, which is both simple in construction and efficient in operation. The tabulating key-lever is connected with a spring-controlled rock-shaft mounted in the rear of the machine and formed with a rack which receives two or more stops co-acting with a scale and serving to arrest the carriage at the predetermined points of its travel. When the tabulating key is depressed, the feed-dog is thrown entirely out of engagement with the feed rack, so that the carriage is propelled by the force of the spring motor until arrested by the first stop. A second depression of the key allows the carriage to travel to the second stop, etc.; and a final depression to the end of its course.

The line-spacing devices consist of a ratchet wheel on the platen shaft, engaged by a pawl operated by a lever having horizontal movement. The horizontal spacing-lever is more easily manipulated than the usual vertical lever. One movement of the lever turns the platen and brings the carriage back to its initial position.

PROGRESS OF WORK ON THE RAPID TRANSIT TUNNEL, NEW YORK.

Work on the New York Rapid Transit Tunnel is now progressing at a rate which gives reason to hope that this great work may be completed within the contract time. We give several views, taken along the line of road, which show the plant and the methods of construction, which latter will vary considerably, according as the line is to be built as a subway or as a tunnel proper.

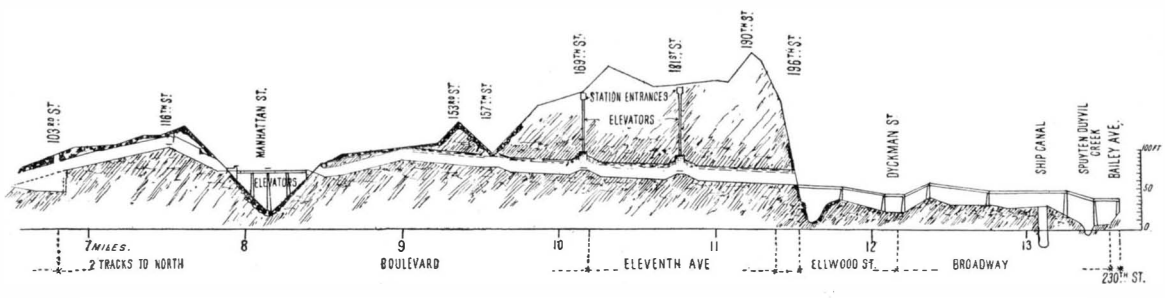
Just here it would be well to explain that strictly speaking the new road should be known as a subway and not by its popular designation of tunnel, and this for the reason that of the total 20 miles to be built, not more than about 3 miles will be laid in a tunnel proper, that is to say, in one which is excavated by driving horizontally through solid material at a depth of several feet below the surface. The term subway is applied to that portion of the road which will be built by making an open excavation, building within it the steel and concrete walls and roof of the subway, and then filling in around the structure and restoring the original surface of the road. Commencing from the downtown terminus, the first stretch of the tunnel encountered will be that which will extend beneath Park Avenue and 42d Street. The next section of any importance will be that reaching from 150th Street to Fort George; while on the eastward branch of the line there will be sections of tunnel where the road passes beneath the northwestern corner of Central Park, and beneath the Harlem River.

The subway is being constructed by what is known as the cut-and-cover method, as shown in one of our illustrations representing the progress of the work on Fourth Avenue below Union Square. A short length of cableway is erected on the western side of the street and with its assistance the excavation is carried down to the required depth, the material being shoveled into the cableway buckets, drawn up and loaded into carts which carry it to a convenient dumping place. As the subway is to occupy the full width of the street, it is necessary to cut away the whole of the underlying material below the tracks of the Metropolitan Street Railway Company, and this has to be done without interfering with the running of the cars. The structure of the underground trolley road is extremely heavy, and as the cars weigh from 8 to 10 or 12 tons apiece, the problem of supporting the structure while removing the material is a rather complicated one. It is met by placing two pairs of massive I-beams, 2 feet in depth and about 35 feet in length, parallel with the tracks and spanning the section to be excavated, and supporting beneath them a series of transverse 12 by 12 timbers, the timbers being secured to the longitudinal steel I-beams by bolts, each timber bearing against the base of the track yokes. With the track thus securely supported, it was possible to excavate beneath the structure without interfering with the traffic. After the excavation has been carried out down to sub-grade, the footings for the steel columns are laid, the columns erected, and the I-beams which form the framework of the walls and roof of the subway are laid in place. The temporary timber false work is then removed and the concrete arches are turned between the steel framing. Following this, four layers of felt and tar waterproofing are laid completely around the concrete, and an outer projecting sheath of concrete and brick is placed over the whole subway. The loose material is then filled in and the street restored to its original surface. Our illustration of the Fourth Avenue work shows the steel framing in place. This framing, by the way, is spaced about 5 feet apart and answers in some sense to the framing or ribs of a modern steamship. During the excavation, provision has to be made for supporting the water and gas mains and cable conduits, and this is done by slinging them by chains from 12 by 12 timbers which are temporarily supported on timber struts.

The particular piece of work to which we have just referred is, in respect of the difficulties of excavation, one of the easiest on the whole route of the subway, the material being loose, sandy soil, easily removable by pick and shovel. Over a great portion of the line, however, the excavation will be through solid rock, and blasting will be necessary. Drilling will be carried out almost exclusively by pneumatic drills, and to provide the power for operating these, two out of several power stations have already been erected, one in Union Square, and the other at 165th Street and the Hudson River. The compressed air is led from the station by 8 and 10-inch mains of steel pipe, the mains being laid parallel to the route of the tunnel throughout the sections which they are intended to serve. The air is led from the mains to the drills by flexible piping. Our illustration shows the 165th Street plant, which at present consists of four 125-horsepower locomotive boilers, and two Rand compressors, with steam cylinders 36 inches and air cylinders 24 inches in diameter, by 2 feet 6 inches stroke. At present the air is delivered at 90 pounds pressure, but ultimately when two more compressors are added, and work is being carried out on a more extensive scale, the pressure is to be increased.

Although not much of the rapid transit road will lie in tunnel proper, where it does pass beneath the surface it will, in places, lie at a very considerable depth, particularly beneath Washington Heights. In the stretch of about 2¼ miles, from 150th Street to 195th Street, the road will be at an average depth of about 120 feet below the surface of Broadway, and in that distance there will be two subterranean stations, one at 169th Street, one hundred feet below the street, and another at 181st Street at a depth of 120 feet. The latter station and the elevators and tunnels by which it will be reached are shown in section in one of our front-page engravings. The vertical excavation for the shaft will contain two large elevators and a stairway, the stairway being provided in case of a breakdown at any time in the elevator service. The station will consist of a large chamber excavated in the solid rock, the roof being in the form of an elliptical arch. There will be two elevator landings at the bottom of the shaft, the upper one of which will discharge its passengers at the level of a bridge, which will extend across the tracks and enable the passengers to reach the downtown tracks. During the morning hours the elevators will stop at this level, for the reason that almost all of the travel at that time will be in the downtown direction. During the evening hours, when business men are returning from the city, the elevators will run to the lower level, so as to save passengers the necessity for climbing any stairways. The elevator cars will be unusually large, with sufficient capacity to remove all the passengers unloaded from one train before the next train enters the station. The excavation for the 169th Street station is so far advanced that the vertical shaft and the transverse tunnel leading from the shaft to beneath Broadway are completed, and about 25 feet of drifting has already been completed north and south beneath Broadway on the line of the tunnel itself.

One of the most interesting portions of the work, just now, is the excavation between 156th Street and 158th Street. By reference to the accompanying profile of the line, it will be noticed that this stretch of line is located at the bottom of the depression between 153d Street and 163d Street, where the tunnel approaches very nearly to the surface of the ground. For a distance of about 600 feet the material will be taken out in open excavation, as shown in our photographs, the steel caging of the subway being built in place and the road restored to its original surface in the manner already described. Drifting is being carried actively forward at 158th Street, and we present two views of the drift, one looking north, and the other looking south from the interior of the tunnel. Excellent progress is being made on this section of line, and it is likely that it will be one of the first portions to be completed. Our thanks are due to William Barclay Parsons, the chief engineer, and George S. Rice, the principal assistant engineer, of the Rapid Transit Tunnel, for courtesies extended in the preparation of this article.



PROFILE OF THE RAPID TRANSIT TUNNEL FROM 103d STREET TO BAILEY AVENUE.

Experiments in Long-range Rifle Fire.

That the modern magazine rifles are capable of carrying long distances has been borne out by the Boers having been able to inflict considerable damage upon the English at a range hitherto deemed impossible, and this fact has been specially emphasized in those cases where they have had an opportunity of previously ascertaining the correct range. In the British army the soldier has never been drilled in rifle fire at a greater range than 1,000 yards. To exactly ascertain the efficacy of rifle fire at a long range, Sir William Butler, formerly commander-in-chief of the South African forces, has been carrying out some interesting experiments at the Aldershot camp. A body of infantry were supposed to be marching in columns over an open space, the range of which was known to another force holding an intrenched position a considerable distance away.

The advancing columns were represented by eighteen large canvas screens, each measuring 90 feet in length and 6 feet in height, and separated from one another by a distance of 25 paces, so that from the front rank to the rear rank occupied about 1,200 yards. The screens were painted light brown in color, and closely resembled the shade of the sandy soil upon which they were placed. The intrenched position was held by a selection of marksmen at a range of 2,000 yards. Each soldier was supplied with fifty rounds of ammunition. At this range the soldiers could not descry the canvas screens without the aid of field glasses, and then only the front screens were visible, those in the rear being hidden by the configuration of the ground. Near the screens the marker's hut had been erected, and the officer in charge was connected with the intrenched position by telephone. Fire was first directed upon the targets from a range of 1,900 yards, and finally increased to 2,200 yards. At first the shots were fired singly and the effects of each notified, the results being very satisfactory. Then volley firing was practised with equal success. In all 2,000 shots were discharged, 15 per cent of which were reported as hits. The front screen was completely riddled. Of course, numerous shots fell between the screens, and although they were not considered in this test, they would have yet been useful, since they would probably have hit the feet of enemy. The experiments proved the high carrying capacity and efficiency of the Lee-Enfield rifle and the accuracy of its sighting.

A New Barometer.

At the recent meeting of the British Association, A. S. Davis, of Leeds, showed a most interesting barometer. A glass tube ten inches long and an inch in diameter ends in a bulb below and reaches above into a mercury basin. The mercury flows down the tube, compressing the air. When not in use, the barometer with its stand is kept upside down. It is inverted for use, and a reading quickly taken when the column has come to a standstill. When the ordinary barometer rises, this one falls. The tube is water-jacketed, and a calcium chloride tube is inserted to dry the small quantity of air sucked in. The readings are said to be very accurate, though the range of each instrument is small.

THE SELDEN PATENT SUIT.

In our issue of August 4, we commented editorially on the suits for patent infringement then about to be commenced by the Electrical Vehicle Company against the foremost manufacturers of gasoline carriages in this country. The case was recently heard in the United States Circuit Court for the Southern District of New York, on a demurrer filed by the Winton Motor Carriage Co., the principal defendants in the first suit. It will be remembered that the Electrical Vehicle Company purchased the patent which it now holds from George B. Selden, a patent attorney, who filed an application on May 8, 1879, for a "road engine," driven by a hydrocarbon motor, and who received his letters patent from the government on November 5, 1895. The long interval between the filing of the application and the granting of the patent was due primarily to skilful maneuvering on the part of Mr. Selden. As a patent attorney he knew that under the law which was in force up to 1897, an application for a patent could not be considered to have been abandoned if prosecuted within two years after the last official action. By complying with the letter of the law, Mr. Selden managed to delay the granting of his patent for sixteen and one-half years.

The record of the case in the Patent Office shows that the application was rejected May 31, 1879, and that an amendment was filed May 26, 1881, nearly two years later. A second rejection on June 17, 1881, was followed on May 15, 1883, by another amendment; and a third rejection on May 26, 1883, was met by an amendment filed on May 18, 1885. An official letter sent to Mr. Selden on June 15, 1885, was not acted upon until June 13, 1887, only two days before the expiration of the two years of grace allowed by the statute. Another rejection on June 21, 1887, was answered by a letter dated April 13, 1889, and by an amendment filed June 10, 1889. Mr. Selden was required on June 14, 1889, to furnish a "smooth copy" of the specification prior to issue; but although the application was otherwise ready for allowance, it was not until June 5, 1891, nine days before the statutory limit, that the substitute specification was filed. An official letter of July 1, 1891, demanded a new oath prior to issue; but it was not until June 28, 1892, that Mr. Selden obeyed the order. The case was then transferred to another examiner, by whom some of the claims previously allowed were rejected on July 29, 1893. The next amendment was filed on April 1, 1895. The patent was finally granted on November 5, 1895, just at about the time when the motor carriage began to make its appearance in the streets of our large cities. All of the nineteen original claims were canceled.

In every instance the tardiness seems to have been due to the action of the applicant rather than to any delay on the part of the Patent Office. In extenuation of the long interval between the application and final allowance, it may be urged that, had Selden received a patent in 1879, he could hardly have derived any benefit from the practical application of his invention, in view of the state of the automobile industry at the time. The scope of Selden's claims and the fact that he seemed to be a pioneer in his particular field of activity—indeed, the Commissioner of Patents has even stated such to be the case—induced the Columbia and Electrical Vehicle Company to purchase the patent.

The nature of Selden's invention may be seen from the accompanying drawings, reproduced from the letters patent. Fig. 1 is a side elevation of the carriage; Fig. 2 a front elevation, and Fig. 3 a vertical section through the engine employed.

The motor, *L*, is mounted on the front truck, with the cylinders arranged transversely to the driving-shaft and the air-reservoir, *O*. The carriage axle is driven from the motor by the gears, *M N*. "Any form of liquid-hydrocarbon engine of the compression type may be employed," says Mr. Selden in his specification. In the carriage shown, however, air is compressed into the reservoir, *O* (Fig. 3), by an air pump, *d*, and admitted to the working-chamber, *R*, by a valve, *f*, operated by a cam-shaft, *S*. Gearing, *M*, is employed to drive the cam-shaft. As air is admitted to the working-chamber a quantity of liquid hydrocarbon, taken from the tank, *U*, is injected into the combustion chamber, *T'*, by the pump, *g*. The products of combustion are ejected from the pipe, *X*, by the opening of the valve, *V*, through the medium of the cam-shaft, *S*.

A clutch, *Y*, might be interposed between the motor and the gearing, *M N*, in which case the cam-shaft, *S*, was to be positively driven. By means of this clutch Selden was enabled to throw the driving-axle in and out of gear, an arrangement now used on every gasoline carriage. Selden saw the inconvenience of extinguishing the ignition flame or of closing the exhaust valve in order to bring the carriage to a standstill. The necessity of starting up the motor by hand rendered the provision of a device whereby the carriage could be stopped, although the motor were still in operation, of no little importance. He, therefore, introduced the clutch, which, it may be safely said, constitutes one of the cardinal elements of his invention.

The traction wheels, *B*, of the carriage are attached to the axle by clutches, splined on the driving-shaft and held in mesh by springs in order to enable the wheels to rotate independently and to facilitate the turning of corners. The arrangement, though crude, is not a bad substitute for our modern differential

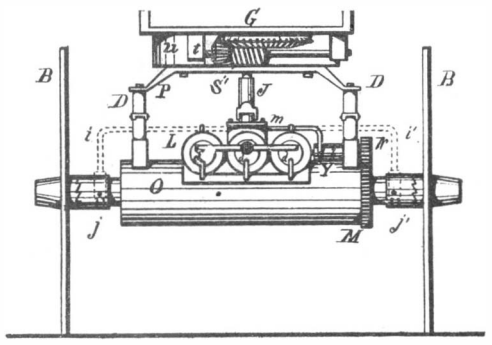


Fig. 2.—FRONT ELEVATION OF SELDEN CARRIAGE.

gear. The clutches are actuated by hand-wheels, *I*. The air inlet, *d'* (Fig. 3), is likewise controlled by one of the hand-wheels, through the medium of gears, *c'*. The inlet supply valves between the tank, *U*, and the pump, *g*, are opened and closed by a cord, *e'*, connected with a hand-wheel, *I*.

The steering apparatus consists merely of a worm-gearing driven from the hand-wheel, *A*.

In order to reverse the vehicle, Selden intended either to employ the system of reversing gears used in connection with the feed-screws of engine-lathes, or preferably to use a crane-neck, whereby the driving-

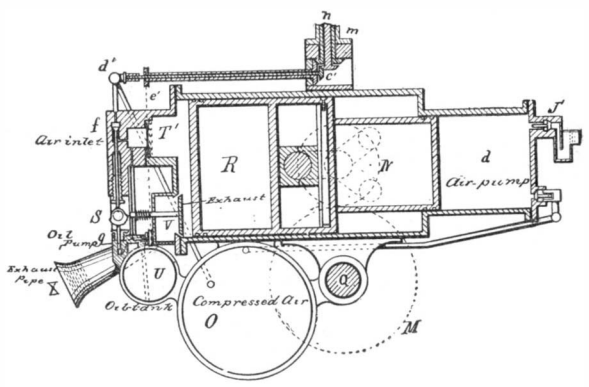


Fig. 3.—VERTICAL SECTION THROUGH MOTOR.

wheel could be turned completely around underneath the body.

From this brief description of Selden's "road engine," it is evident that almost every important feature of the modern petroleum automobile is included in the operative mechanism. The main points are covered in the first and broadest of the claims, which reads:

"The combination with a road locomotive, provided with suitable running gear, including a propelling wheel and steering mechanism, of a liquid hydrocarbon gas engine of the compression type, comprising one or more power cylinders, a suitable liquid-fuel re-

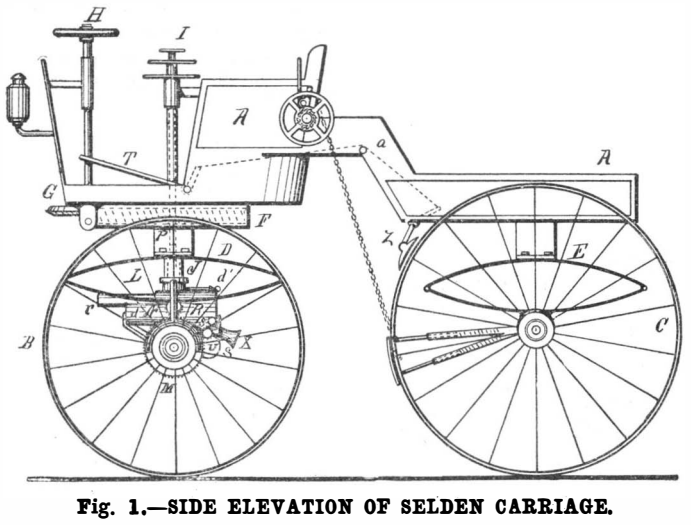


Fig. 1.—SIDE ELEVATION OF SELDEN CARRIAGE.

ceptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device, and a suitable carriage body adapted to the conveyance of persons or goods."

Whether the Selden patent be valid or not is a question which can be definitely answered only by the courts. Certain it is, that if the charge of infringement be sustained, the shops of many an automobile maker will be closed. In the demurrer filed by Mr. A. S. Pattison for the Winton Motor Carriage Co. et al., it was urged that the patent on its face was void for lack of patentability; that the specification conceded that all the elements of the combinations of the claims were old; that steam-engines had been long employed to propel road wagons; that liquid-fuel had been used to generate steam; and that gas engines were old and their use, as well as that of other motors, had been proposed for tram cars and like vehicles. It was argued that the substitution of a gas engine for a steam engine to propel a vehicle did not require inventive faculty. In his decision Judge Coxe stated that the invention, if there was one, had been made very early in the history of motor carriages and that judicial notice would be taken of the fact that, prior to May, 1879, the art of propelling vehicles by motors was in its infancy. "If the thousands of steam and electric 'automobiles' which now are constantly perambulating the streets of every large city had been available as models, the task of constructing a successful 'gasmobile' would have been less difficult. In other words, the fact that Selden's work was done over twenty-one years ago should not be lost sight of in estimating the value of his achievement."

"Upon the present record he must be regarded as the first to construct a road locomotive provided with a liquid-hydrocarbon gas-engine of the compression type so arranged as to leave the platform of the carriage unobstructed." Continuing in his analysis of the case the learned judge proceeds to argue that "on demurrer it must be assumed that Selden has made a self-propelling vehicle which is capable of traveling on ordinary country roads, going up and down hill, and making long distances without replenishing its fuel receptacle. Surely, it required invention to construct such a machine." The judge furthermore questioned the fairness of the assertion that "in no circumstances could it involve invention to create the patented machine because similar machines had been propelled by electricity and steam, and machines, differing radically in structure and purpose had been propelled by gas." He thought that the complainants were entitled to a more liberal interpretation of the patent than that contended for by the defendants and was clearly of the opinion that the immense weight of authority sustained the proposition that the patent could not be held invalid on demurrer.

Patent and Trade Mark Rights in Cuba.

The Military Governor of Cuba has recently issued an order which is of the highest importance to owners of United States patents or trade marks registered in Cuba, and to any person or concern now having a commercial or manufacturing establishment in Cuba, as well as to those who may contemplate an extension of their business to that island by local agencies.

The order prescribes that every owner of a Cuban commercial or industrial establishment, as well as every owner of Cuban patent or trade mark rights, shall have his name and other particulars entered in the Mercantile Register within eight days following the commencement of his business or the opening of his establishment. Presumably, as regards patents or trade marks, the period of eight days will run from the day on which the patent or trade mark right is secured in Cuba. For failure to register within the period named, the merchant or manufacturer will be fined twenty-five dollars United States money. So far as existing establishments, patent and trade mark rights are concerned, the month of November, 1900, is allowed for having the requisite entry made, but from December 1, 1900, the eight-day period above mentioned will obtain.

The order further provides that sales, assignments, transfers or leases shall not prejudice a third party as long as they are not recorded in the Mercantile Register. It also allows creditors whose names are entered upon the said register to record, under certain circumstances, the names of their debtors together with the amount of each debt, and on the other hand the courts may order attachments to be recorded in said register.

The purchaser of a commercial or industrial establishment or of a patent or trade mark right becomes jointly and severally liable with the party who made the transfer for all debts that shall have been registered or attachments that shall have been recorded until the time when the sale or transfer was recorded.

The reason given for the issue of the order (of which we have stated only the main provisions) is the inadequacy of the Cuban laws to protect creditors, since it appears that the purchaser of a business is not (unless bad faith or collusion can be proved) responsible for the debts contracted for the business by the party making the transfer. This state of affairs has, of course, materially interfered with the credit of retailers throughout the island, and the present order seeks to establish better conditions.

THE Spanish-American Congress opened November 8, at Madrid. About thirty South American delegates arrived, and all the South American republics, except Bolivia, have accepted the invitation, and Portugal will also be represented. The influence of Spain will not predominate, as each state is represented by only one vote.

REMARKABLE GRAVESTONE AT FORRES, SCOTLAND.

BY C. FIELD.

This little town of Forres, in the northeast of Scotland, is known to most people from its mention in "Macbeth," the opening scene of which play is set on "A blasted heath near Forres." Local tradition assigns a clump of trees on a moor, some miles to the westward, as being the spot where Macbeth and Banquo met the three "foul and midnight hags." But the real lion of the locality is the lofty runic pillar known as "Sueno's stone," with an ornamental cross on the one side and a complicated array of men, horses, and birds on the other, which is said to commemorate a battle fought between the Scots and the invading Danes in the year 1014. But although no story attaches to it, the stone here pictured, which is hidden away in a dark corner outside the little museum which the town boasts, is surely one of the most curious among the many quaint and grotesque tombstones which are scattered over the United Kingdom. It is said to have once stood in the churchyard, and is probably two or three hundred years old. It is remarkable that no indication is given as to whose memory it was first erected, unless the large capitals at the top are the initials of some unknown name. The carving is bold and somewhat original, though not of any artistic merit. The hour-glass, coffin, and skeleton are much more like what they are supposed to represent than is (it is to be hoped) the angel with the trumpet. Possibly the skull between two heads at the base of the stone is an allegorical representation of Death dividing husband and wife.

REMARKABLE GRAVESTONE AT FORRES, SCOTLAND.

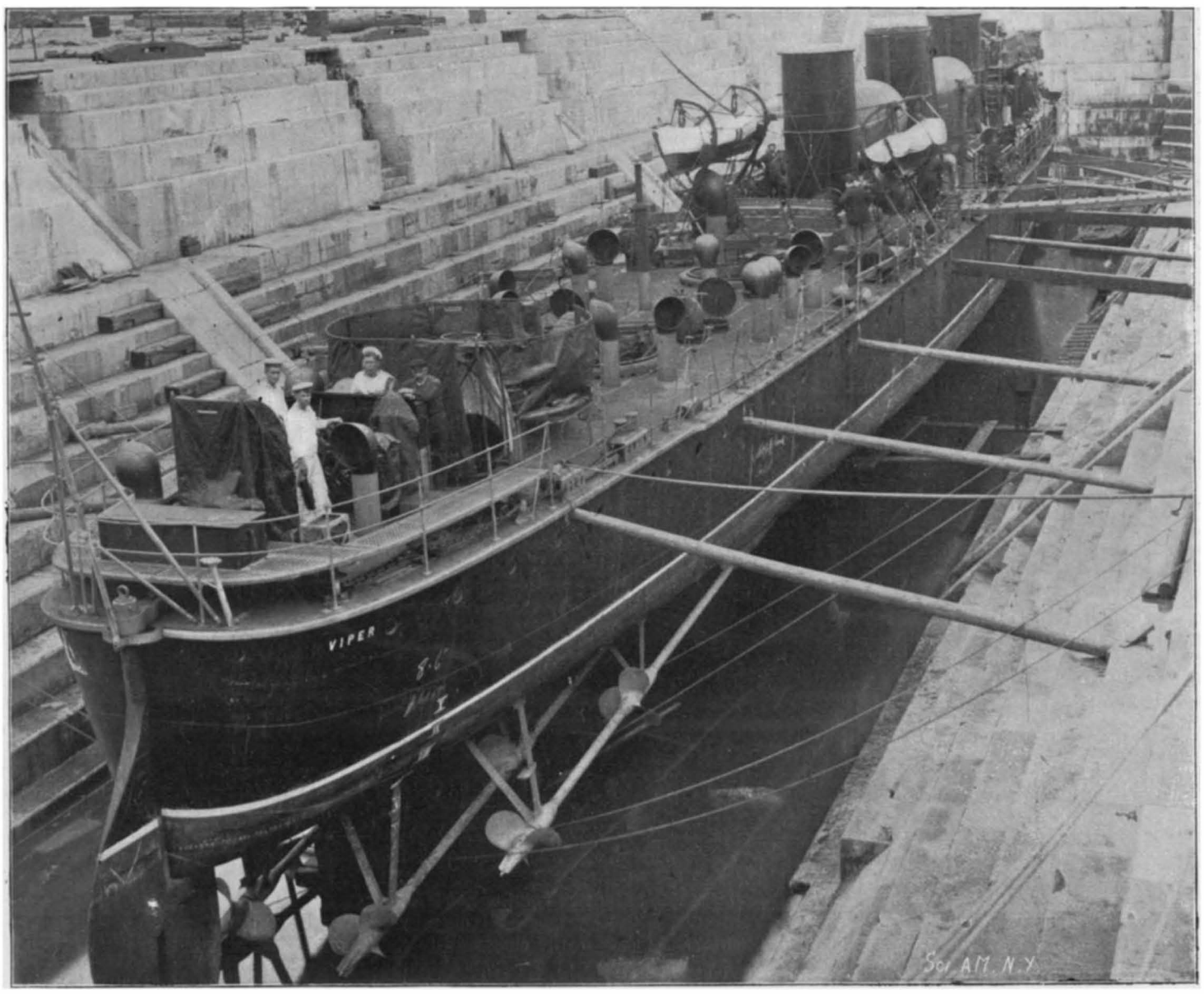
THE TORPEDO BOAT "VIPER" IN DRY DOCK.

It is no exaggeration to say that the remarkable little craft which forms the subject of our illustration is attracting more attention just now than any other vessel afloat. Much of this interest is of a popular nature, and is due to the sensational speeds which she has attained. The public appetite is always whetted by the performance of superlative physical results, and it seldom stops to ask whether these results have any permanent economic value; whether they will or will not further the world's material interests. Popularly considered, the "Viper" is unquestionably the sensation of the hour, for it stands to-day with an accepted official mean speed of 36·58 knots and a maximum speed of 37·1 knots an hour.

Of the question of the economic value of this performance, there may be, and probably is, a division of opinion, and we must wait until the full details of the trials are known, and until the vessel has been given a sufficiently extended trial in active service to establish its durability and all-round usefulness. Even then there will be found a large number of professional men who will doubt the utility of such a boat and such a speed under any circumstances. Personally, we are disposed to give every credit to Mr. Parsons for suggesting in the "Viper" what are the speed possibilities of the future for vessels of larger size and more pronounced utility. Mr. Parsons has recently stated that the application of the steam turbine to larger vessels has been fully considered, and he states that, as regards its adoption for warships, adequate experiments on large steam turbines have made it evident that "with turbine machinery occupying less space than the present cramped-up reciprocating engines, considerable reductions in coal consumption at all speeds would result, consumptions which at some speeds would be quite unprecedented in warships, and analogous to the consumptions attained in the best mercantile marine engine."

Our illustration shows the methods adopted for utilizing the 12,000 horse power which was developed in the recent official trials of the "Viper." Four shafts are used, with two propellers on each shaft, the after propeller having a coarser pitch than the forward one. Each pair of shafts on either side is driven by a compound condensing turbine, the high-pressure driving the outer, and the low-pressure turbine the inner shafting. Forward of the low-pressure turbine, in each case, and on a common shaft, there is placed a smaller high-pressure turbine, which is used for driving the boat astern at a speed of 15 knots an hour; this arrangement being adopted to overcome the defect, inherent in the turbine, that it is incapable of being reversed. The "Viper," like its sister vessel the "Cobra," is 210 feet long, 21 feet beam, and 12 feet 9 inches moulded depth, with a displacement of 380 tons. It is of interest to note the rapid rise of power for increase of speed in the "Viper" as compared with other torpedo boats of approximately the same displacement; thus, the 30-knot destroyers of the standard type generally steamed on their trials at a speed of 30 knots for an expenditure of from 6,000 to 6,500 horse power, whereas to drive the "Viper," which is only of about 50 tons greater displacement, at 37 knots required the development of 12,000 horse power.

The weights of the motive power equipment are as follows: Boiler room weights with water in boiler, 100¾ tons; engine room weights with auxiliaries and water in condensers, 52¼ tons; while the weight of the propeller shafting and fittings is 7¾ tons. Although the turbo engines, in proportion to the horse power developed, are considerably lighter than engines of the same horse power of the reciprocating type, the total weight of the machinery is not as much less than that of the standard 30 and 32-knot torpedo boats as might be expected, the weight saved in the engines being somewhat offset by the increased size of the boilers and auxiliary machinery necessary to produce the great weight of steam required. In the official trial it was recorded that there was a total absence of vibration, even when the vessel was being driven at its highest speed, a feature which is of great value in a warship, since it enables the vessel to present a steady gun platform. Moreover, should the turbine be introduced into the merchant service, the absence of vibration alone would, with the majority of people, render the vessel thus fitted extremely popular; for it is certain that next to the rolling and pitching motion of the average passenger vessel, the feature which causes the most discomfort is the extreme vibration, which unfortunately seems to be inseparable from the high-speed steamer.



TORPEDO BOAT "VIPER" IN DRY DOCK, SHOWING ARRANGEMENT OF THE EIGHT PROPELLERS.

Length, 210 feet. **Beam,** 21 feet. **Displacement,** 380 tons. **Horse Power,** 12,800. **Speed,** 37·1 knots.

Test of an Emergency Ration.

A campaign is being conducted in Oklahoma Territory, and the men are subsisting entirely on emergency rations, the idea being to test the sustaining qualities of three different varieties. Twenty-five enlisted men comprise the force with which the experiments are being made. Each of the three rations now being tested is inclosed in tin, and is of convenient shape for carrying in the saddle bag or pocket. Each package contains food for one person for a day, and the contents are carefully divided into three equal portions. The first ration is composed of broken wheat which has been baked and evaporated meat. This combination is to be made into soup by simply pouring hot water over it. There are also three cakes of chocolate in this ration, besides pepper and salt. The condition of the men while testing this ration will be closely watched. They will be stripped and weighed night and morning, and a careful record kept of their temperature. The second ration is a combination of meat and bread-stuffs with tea instead of chocolate. The third ration is composed of meal made from peas, evaporated beef and bacon and a package of tea. When the new ration is adopted, it will be kept for distribution at every army post. Directions are given on the tins, and if necessary the rations may be eaten dry.

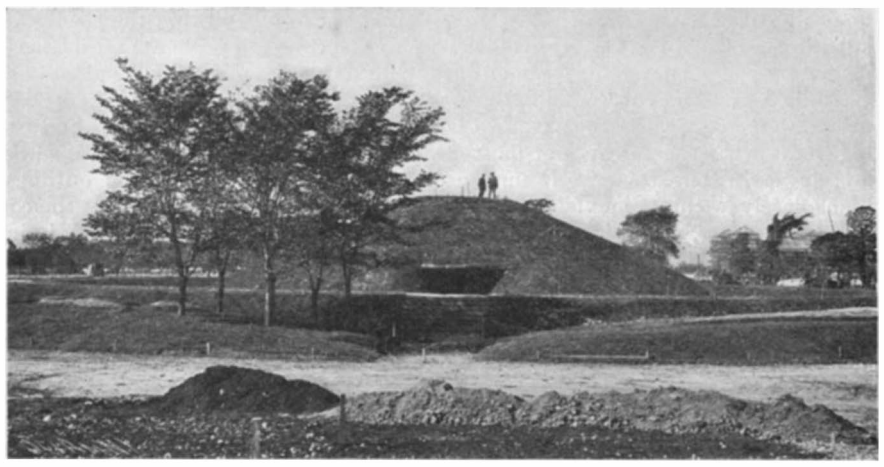
A WIRE fence weaving machine has been devised which enables a strong and serviceable fence to be constructed in position with rapidity and economy. The machine carries a number of spools of wire, and the weaving of the fence progresses rapidly.

PROGRESS OF THE PAN-AMERICAN EXPOSITION.

BY EDWARD HALE BRUSH.

It is scarcely six months since the real construction work of the Pan-American Exposition was begun, yet most of the buildings in the main Exposition group stand to-day practically complete, and in a few weeks will be ready for the installation of exhibits. At the present time the Pan-American grounds present a most interesting scene. The buildings fronting upon the Esplanade and the Court of the Fountains are all under roof. Most of them have been covered with staff, and the staff of several has received its coat of many colors. The admirable character of the arangement of buildings adopted can be very well appreciated, now that the structures are so far along toward completion. Grouping the principal buildings about the two great intersecting courts, each as large as the main court at any previous exposition, secures a splendid effect and ministers also to the comfort of the visitor, who will have comparatively little walking to do in reaching different parts of the grounds. The permanent buildings in the classic style, the $400,000 Albright Art Gallery and the New York State building, both in white marble, will stand among the trees of beautiful Delaware Park, the State and foreign buildings will be to the east of the Triumphal Bridge, and the Midway buildings will be in the northwest portion of the grounds, while opposite, across the Plaza, will be the great structure of the Stadium. But about these two main courts will nevertheless be the

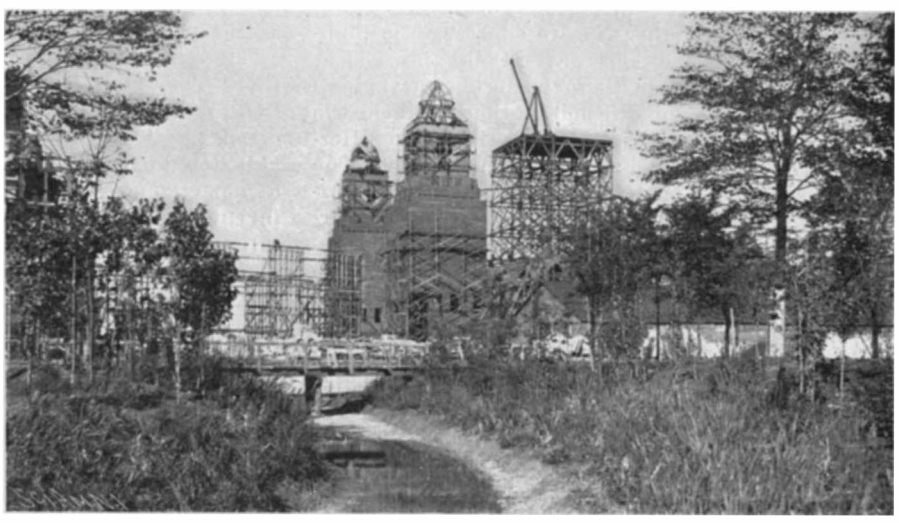
North Towers of Machinery and Transportation Building seen from the Roof.



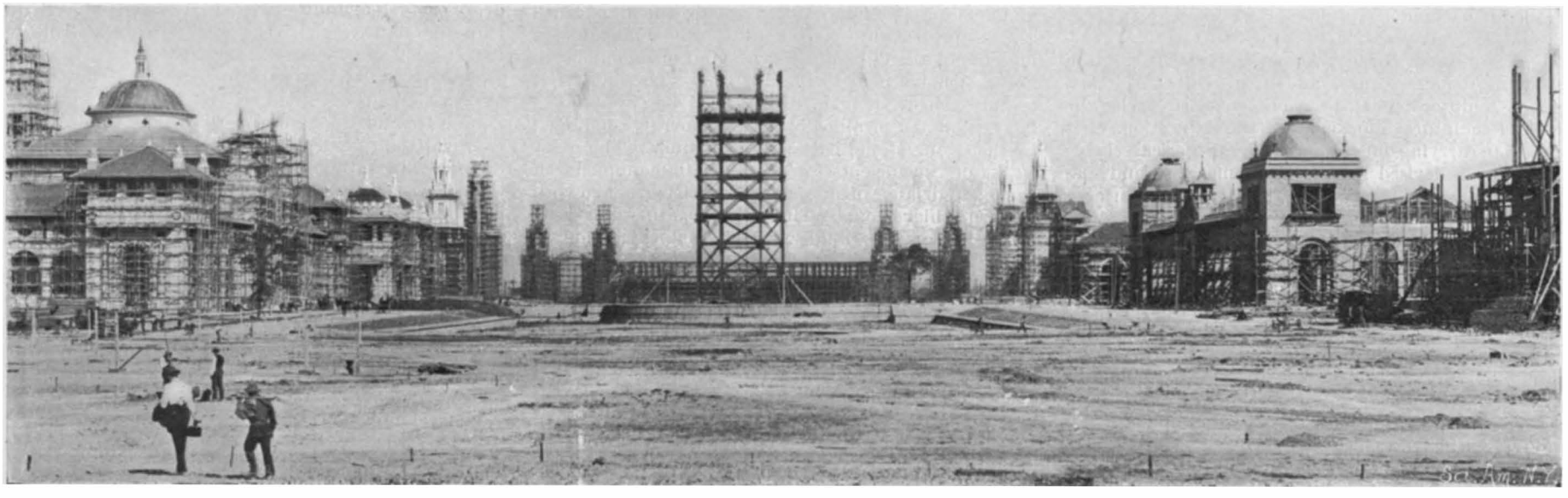
The Burial Mound—A Reproduction of the Work of the Mound-Builders.

The Exposition Viewed Westward of the Service Building.

The Machinery and Transportation Building.



United States Government Building from Grove on Mirror Island.



General View of Pan-American Exposition from the Triumphal Bridge.

THE PAN-AMERICAN EXPOSITION AT BUFFALO, NEW YORK.

great architectural effects of the Exposition. Looking from the Triumphal Bridge, the splendid monumental entrance to this portion of the grounds from the south, one sees looming up at the far end of the vista, at a distance of about one-third of a mile, the Electric Tower which has now reached a height of over 300 feet. Its total height is to be 375 feet. On either side of the Tower and of the Court of the Fountains are the buildings of Electricity, Machinery and Transportation, Agriculture, Manufactures and Liberal Arts, Ethnology and the Temple of Music. To the right, at one end of the Esplanade, are the three buildings constituting the United States government group and connected by colonnades, and to the left are the group for Graphic Arts, Horticulture and Mines, which are connected by conservatories that next sumner will be luxuriant with the rarest and most beautiful plants and flowers. Here then are 13 immense buildings, all immediately within the view, and surrounding these two great courts, and all conforming in greater or less degree to the style of the Spanish Renaissance, which is now seen to be remarkably well adapted to the purposes of the Exposition, combining as it does so many features suitable to the expression of the fantastic ideas and buoyancy of spirit which harmonize with the mood of an Exposition multitude. All of the buildings are to be treated in color instead of left in the monotonous white. These two vast courts around which the buildings are mostly grouped, with the buildings and other architectural features surrounding, gave a splendid opportunity for embellishment in several respects.

The sculptural adornment of the grounds of the Pan-American Exposition will be more profuse and elaborate than has ever before been attempted in connection with a similar enterprise. And in saying this I make no exception of either the great World's Fair at Chicago with its Court of Honor or the Paris Exposition with its Alexander Bridge and other highly embellished architectural features. Practically all of the noted sculptors of Pan-America are at work on groups and individual figures which are to adorn and dignify the buildings and grounds of this Exposition. From the Triumphal Bridge on the south, embellished from end to end with symbolic figures and designs, and with its four stately piers, 100 feet in height, carrying mounted standard bearers, to the Electric Tower on the north with its elaborate sculptural scheme terminating 375 feet above terra firma in a figure of the Goddess of Light of hammered brass by Herbert Adams—from one end to the other of this vista, sculpture in the most bewildering variety will abound, the charming effect of these forms of beauty being enhanced by the garden embellishment, the fountains and cascades, and at night by the soft radiance of the electric lights. There will be sculpture expressive of the beneficence of Mother Nature adorning the fountain at the head of the Court of the Fountains, and at the end of the Esplanade where the horticultural group is situated. At the opposite ends of the Esplanade the sculpture, by such men as R. Hinton Perry and Herbert Adams, will typify man and his institutions. The groups in the Court of the Fountains will be allegorical representations of the ideas dominant in the surrounding buildings devoted to machinery and transportation, manufactures and liberal arts, music, ethnology, agriculture and electricity; and the sculpture of the Electric Tower and its beautiful colonnades will portray the ideas associated with the power of the elements, the mysterious force of electricity, the great waters amid which Buffalo is situated and which have made her so potent an influence in the world of commerce and industry.

There will be some 125 original groups of this sculpture, not including that in the fine arts exhibit in the Albright Art Gallery, and it is engaging the attention of some thirty-five sculptors, including such exponents of this branch of fine art as George Gray Barnard, Frederic Macmonnies, Daniel C. French, Edwin F. Elwell, J. Q. A. Ward, F. W. Ruckstuhl, Philip Martiny, E. C. Potter, Herbert Adams, John Gellert, Ralph Goddard, Isidore Konti, and Karl Bitter, the last named sculptor having been chosen to supervise the work of sculptural adornment of the Exposition. His success in carrying out the ambitious allegorical scheme of sculpture devised for the Pan-American, and embodying in the main his own ideas, marks him as a creative genius of high order. Now that so much of the sculptural work is already done and shipped to Buffalo, the magnitude and beauty of this feature of the Exposition is beginning to be realized, and the fact is appreciated that it will mark an era in the progress of this branch of art in Pan-America.

In another respect the arrangement of the main buildings of the Pan-American group, as they have been placed about these courts, lends itself admirably to the purpose of the architects to secure remarkable and fascinating effects. It renders possible the greatest and most artistic illumination by means of electric lamps and hydraulic effects ever conceived and carried out by human intellect and inventive genius. This illumination, which will be achieved about the Court of the Fountains and the Esplanade, will be a feature of the Pan-American Exposition worthy of the *fin de siècle* enterprise, the story of which is to be told by the Exposition as a whole.

The progress made by electrical science and the harnessing of Niagara within the last decade, make possible this supreme achievement. With the great Falls plant, which within a short time will be generating over 100,000 horse power, within twenty miles of the Exposition grounds, and linked with the Exposition by a transmission line, it is fitting that electricity should receive especial prominence at the Exposition, and that the electrical illumination should surpass all precedents set in this respect. The illuminating area of the courts already described and of the Plaza to the north of the Electric Tower, is three times as large as that at Omaha and two and one-half times as large as that at Chicago, while the character of the buildings, the fantastic outlines many will possess, and their grouping about the courts, will give a peculiar beauty to their penciling in incandescent lights. With the sky lines of the buildings traced in fire against the heavens; with the basin of the Court of the Fountains golden with thousands of floating lights, the cascades resplendent with mysteriously changing fiery hues, and rising above all the stately Electric Tower, one mass of shining splendor from the plashing fountain at its feet to the dazzling Goddess of Light upon its topmost pinnacle,—with such a scene to portray, the most skillful word painter will be at a loss where to begin and where to end his task.

The statement that 200,000 electric lamps will be used in this illumination conveys some idea of its extent, although it is difficult for the average mind to grasp what it means when such a statement is made. There is scarcely anything with which such an illumination can be compared, and the visitor must come to see it in order to appreciate the marvelous brilliancy and beauty of the scene which will be created. The incandescent lamps to be used in this illumination will give a peculiar softness and agreeableness to the quality of the light. Arc lights will be used to light the interior of the buildings, and rows of these lights will border the grounds; but the great illumination will be given through the incandescent lamp, which will be introduced in the fountains and hydraulic features in many novel and startling forms to give a bewitching character to the scene. The electrical experts of the Exposition are now studying on a novel method of turning the light on and off, so that this operation in itself may be one of the wonderful features of the electrical display.

"The Progress of Invention in the Nineteenth Century."

Edward W. Byrn, A.M., has done a signal service to the history of invention in writing a dignified and authoritative treatise upon the evolution of the arts and sciences during the last hundred years, entitled the "The Progress of Invention in the Nineteenth Century," which has just been issued by the publishers of the SCIENTIFIC AMERICAN. The author is admirably qualified to deal with the subject, having been for a quarter of a century engaged in the examination of inventions for patents and having, withal, an ardent interest in all things that make for scientific progress. He has presented a most excellent bird's-eye view of the progress achieved, and he has given in concrete form the great scientific and engineering achievement of the century. The author presents his subjects with a pure and rhetorical diction, conveying the thought in a terse and lucid way, while still holding true to the technical nomenclature of the arts. The chapters of this book give a most comprehensive, compact, and coherent account of the progress which distinguishes this as the "golden age" of invention, and which has resulted, especially in the United States, in an unprecedented industrial and commercial development.

Standing on the threshold of the twentieth century, and looking back a hundred years, the nineteenth century presents in the field of invention a magnificent museum of thoughts crystallized and made immortal, not as passive gems of nature, but as potent, active, useful agencies of man. The period has been a brilliant campaign of allied brains and energy, conducted by the strongest and best equipped minds. The great works of the ancients are in the main monuments of the manual labor of myriads of workers; not so with modern achievements. The present century has been practically an age of ideas which find expression in labor-saving inventions, often the product of a single man. To appreciate what has been done, the conditions of to-day must be briefly contrasted with those of a hundred years ago. This is no easy task, and Mr. Byrn has admirably accomplished it in "A Perspective View," a short introduction which forms the first chapter of the book. The second chapter is entitled "Chronology of the Leading Inventions of the Nineteenth Century." Each year has listed under it the important discoveries and inventions, together with their authors, which enables the reader to ascertain at a glance the most important inventions and discoveries of any particular period. Thus, it will be seen that in 1815 Sir Humphry Davy invented the safety lamp; that in 1821 Faraday converted electric current into mechanical motion; that in 1895 Cowles introduced the electrical process of manufacturing aluminium; and that in 1896 Marconi devised his system of wireless telegraphy.

A sample year or two may prove interesting:

1804. Rhodium and Palladium discovered by Wollaston. First Steam Railway and Locomotive, by Richard Trevithick. Col. John Stevens Applies Twin Screw Propellers in Steam Navigation. Winsor Takes Out British Patent for Illuminating Gas, Lights Lyceum Theater and Organizes First Gas Company. Lucas' Process of Making Malleable Iron Castings.

1893. Acheson's Process for Making Carborundum. The Yerkes Telescope. Edison's Kinetoscope. Production of Calcium Carbide in Electric Furnace by Willson.

These are a few examples taken at random from a list which covers a hundred years of invention. This list must not be confounded with the general classification of the subject matter which comprises the principal part of the book. The third chapter is devoted to the Electric Telegraph, and in it will be found a photograph of Prof. Henry's original electro-magnet and a number of other engravings which admirably serve to elucidate the text, including one showing Marconi transmitting the news of the yacht race of 1899 by wireless telegraphy. The next chapter is devoted to the Atlantic Cable, and this is in turn followed by one on the Dynamo and its applications, accompanied by a number of excellent engravings.

The Electric Motor, the Electric Light, the Telephone and Miscellaneous Applications of Electricity follow. The Steam Engine occupies three chapters, one devoted to the Steam Engine including turbines, another to the Steam Railway, and a third to Steam Navigation. The chapter on Printing gives in the most comprehensive manner the development of the printing press from the time of Benjamin Franklin to the latest octuple press. It also includes the manufacture of paper pulp and the setting of type by the linotype. The chapter on the Typewriter, Sewing-machine and Reaper are fascinating and show that the story of invention is not without its romantic element. In the chapter on Vulcanized Rubber, in which the struggles of Charles Goodyear are described, this is even more pronounced. The chapters on Chemistry, Food and Drink, Medicine, Surgery and Sanitation give a vast amount of information which is not readily accessible. The Bicycle and Automobile are treated at considerable length, and the chapter is well illustrated. The Phonograph, Optics, Photography, X-Rays, all have chapters devoted to them. Gas-lighting, Civil Engineering, Wood-working, Metal-working, Firearms and Explosives, Textiles, Ice Machines, Liquid Air and minor inventions are all treated in most interesting chapters. The book is admirably illustrated and is attractively printed and bound.

Latest News of the Peary Expedition.

Further details of the Peary expedition have now come to hand. Dr. Leopold Kann was the only member in that party who arrived on the whaler "Eclipse" from Davis Strait. Dr. Robert Stein, of the United States Geological Survey, decided to wait for transportation which would land him in America, and Mr. Samuel Warmbath of Boston wished to remain at Cape Sabine for a time. Lieut. Peary passed the winter at Etah on Smith Sound, near the spot where Dr. Hayes had his winter quarters in 1860, and not far from the scene of the Greely disaster. In February and March Dr. Kann's winter house at Bedford, on Pym Island, was visited three times by members of the Peary expedition; the last time Lieut. Peary himself commanded the sledging party. The Lieutenant stated that about ten months previously he had met Sverdrup in the Kane Basin, north of Smith Sound. The Sverdrup party had fully explored Ellesmere hinterland, mapping out a region that was hitherto a blank on the charts. When the Peary and Sverdrup parties separated, it was Sverdrup's intention to explore the vast area of land and water in and around Jones Sound beyond Cape Eden. Dr. Kann believes that Sverdrup, on the "Fram," is now wintering in Jones Sound. The autumn has been very tempestuous, and the ice was such as to render navigation next to impossible, and it is not thought that the "Fram" will come home this year. Lieut. Peary had two hundred dogs and twenty-seven sledges, but underrating the difficulties of the journey, and not having a sufficiency of food, most of his dogs died. Dr. Kann considers that it is certain that Lieut. Peary is now wintering at Fort Conger. When Dr. Kann left Cape York on the "Eclipse," on June 9, the "Windward" expected to touch there about the middle of July, where orders from Lieut. Peary which Dr. Kann had brought were left with the Esquimaux.

THE Russian government has decided to make the metric system of weights and measures compulsory, and the Minister of Finance is now engaged in considering the time and manner of introducing this reform.

II. THE ELECTRIC CHIME.

BY GEORGE M. HOPKINS.

To secure practice in mechanics or in electrical work, the amateur may as well construct something for actual use. A very useful and pleasing electro-mechanical device is an electric chime to be used as a door bell or call bell, or in connection with a clock. It serves its purpose as a call and gives an ever-changing series of harmonic notes.

The first step toward the construction of this device is to purchase the toy known as the tubophone, and select three of the tubes which produce a chord, or if the maker prefers it, he may buy a piece of mandrel drawn brass tubing, ⅝ inch external diameter, with walls $\frac{1}{32}$ inch thick, and cut off three pieces respectively 7⅝, 8⅜, and 9⅜ inches in length; each of these should be laid upon two short pieces of soft woolen cord, with the cord touching at nodal points, that is, at exactly one-quarter of the length from the end. Arranged in this way the tubes give out a clear note when struck with a small wooden mallet. By comparing these notes with those of a piano or other musical instrument, the tubes may be tuned. The pitch is raised by shortening the tube, but as there is no practical way of lowering the pitch after the tube has once been shortened, it would be advisable to cut the tubes a little longer than the measurements given. A baseboard having a short standard is provided, and to the upper portion of the standard is secured a board into which are driven three pairs of wire nails, the nails in each pair corresponding in position with the nodes of one of the tubes. The tubes are suspended from these nails by soft cords passing around the tubes at the nodes or points of no vibration, leaving the tubes free to vibrate at the center and at the ends.

Now it remains to construct the electro-mechanical device for striking the tubes. To the baseboard are secured the angled ends of three strips of spring brass, $\frac{7}{32}$ inch wide and $\frac{1}{32}$ inch thick, which extend above the tubes and carry small wooden mallets in position to strike the middle portion of each tube. The mallets are secured to the springs by means of ordinary wood screws passing through the springs into the mallets.

Behind the springs, at or near their mid-length, is placed a diagonal strip of wood, having secured to its outer edge a strip of felt or chamois skin. The spring strikes this piece and allows the mallet to strike the tube and spring back without jarring. Behind the springs is supported a small shaft on which is placed a wooden cylinder about 1 inch in diameter and 2½ inches long. In the cylinder and opposite the springs are inserted wire nails, arranged to strike short inclined strips riveted to the springs. The nails are placed so that they will strike the inclined strips in different orders; for example: 1, 2, 3; 3, 2, 1; 2, 3, 1; 1, 3, 2.

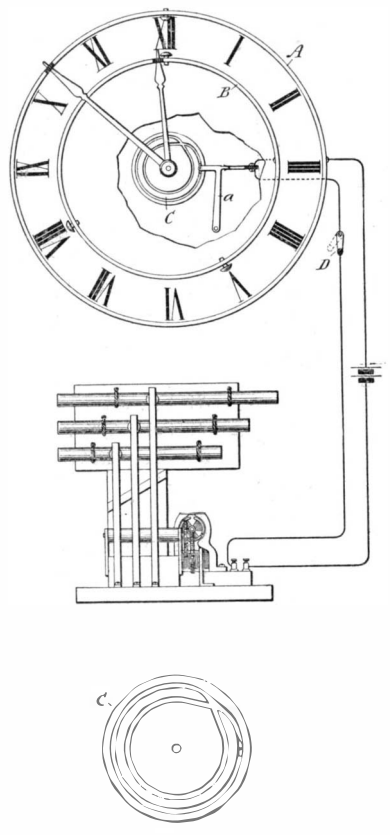
A toy electric motor having a three-pole armature is used for turning the cylinder, and two clock wheels and a pinion are employed for reducing the speed. A worm is placed on the armature shaft of the motor, which engages the first of the clock wheels. This worm may be cut in a lathe, but if this is inconvenient, a wire may be wound spirally around the armature shaft and soldered. It will, of course, be necessary to wind the spiral so that it will fit the teeth of the clock wheel, and the surplus solder should be scraped from the wire to diminish friction. The motor is provided with binding posts to receive the battery wires. One or two cells of dry battery will run the chime. The chime is used in place of an ordinary call or door bell, or it may be used in connection with a clock, as shown, for making calls at certain hours.

The push button shown in the sectional view is made to close the circuit when the chime is used in place of a call bell or door bell. The button is readily made by boring a small block, *A*, of hard wood in two diameters to receive the head and back of the pearl collar button, *B*, the back of which is held in place by the apertured piece of veneering secured to the face of the block by small screws, while the head of the button rests on a curved brass spring, *C*, secured in a slot in the back of the block, *A*, by a screw. The outer end of the spring projects beyond the side of the block to receive one of the circuit wires. This slot is filled below the spring with insulating material, and a brass plate, *D*, is secured to the back of the block, *A*, and has upon one edge an apertured ear for receiving the other circuit wire. The plate, *D*, is secured to the back of the block by small screws. The free end of the spring, *C*, is curved over to a point near the brass plate, *D*, so that when the spring is depressed by pressing the button, *B*, it will touch the plate and close the circuit.

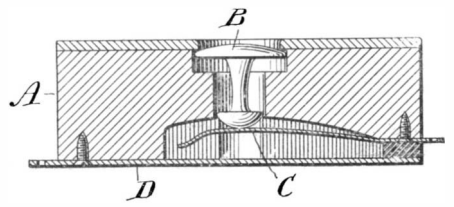
The annexed diagram shows an appliance which enables the chime to be used in connection with a clock. In front of the dial of an ordinary clock are secured the rings, *A*, *B*, made of $\frac{1}{16}$ inch square brass wire. The supports are of insulating material, and the rings are concentric with the arbor carrying the hands. The hands are bent outwardly to permit of extending over the rings without touching them, and to insure the hands against electrical contact with the rings a thin short sleeve of paper is slipped over each hand near the free end. Each ring has several small radial holes bored in it to receive the brass nails, the heads of which project sufficiently beyond the front surface of the rings to enable the hands to touch them as they pass.

The circuit wires connecting the battery and the chime are connected one with the outer ring, *A*, the other with one of the springs of the cut-out switch shown in the opening formed by the breaking away of the dial. The other spring is connected with the inner ring, *B*. The springs are insulated from each other.

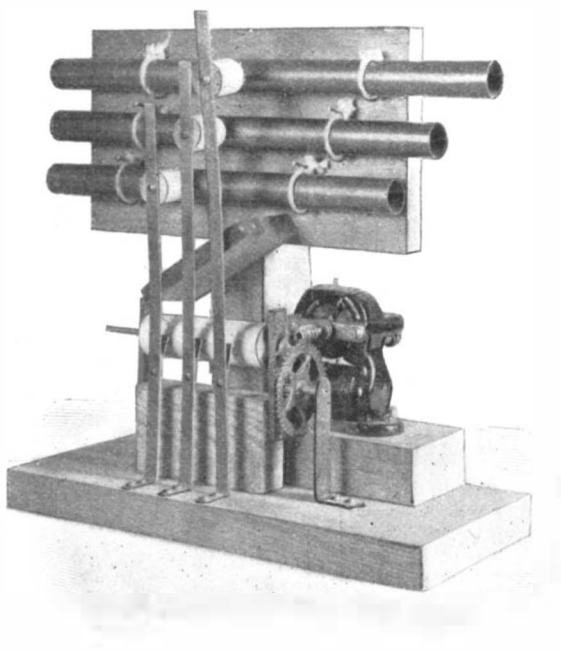
On the sleeve which carries the hour hand is mounted the crossed slotted cam, *C*, also shown detached in the larger figure. In the slot of this cam is a boat-shaped follower which slides easily in the slot



CHIME WITH CLOCK CONNECTION.



PUSH BUTTON.



ELECTRIC CHIME.

and is longer than the width of the slot, so that it can, in following the slot, take the inner and outer portions of the slot in alternation. The follower is pivoted to the angled lever, *a*, which is pushed by the cam between the parallel springs and withdrawn from them in alternation once in 12 hours. The object of this arrangement is to cut out the chime at night and put it in the circuit in the daytime. The cam, *C*, and the angled lever, *a*, are insulated from the clock movement.

A switch, *D*, is provided for throwing the device out of action at any time.

It will be seen that the hour hand must come into contact with the nail on the inner circle and the minute hand must touch the nail in the outer circle to complete the circuit, and cause the chime to sound. The duration of the chiming is limited by the time the minute hand is in contact with the nail. The clock when arranged as here shown sets off the chime at 8 o'clock, 12 o'clock and 5 o'clock. It is now about to ring the chime for 12 o'clock.

The Automobile Exhibition at Grand Central Palace.

Practically the whole of the exhibits which were displayed in the late exhibit under the auspices of the Automobile Club of America, at Madison Square Garden, are to be seen at the Grand Central Palace Exposition of this city, which is to run for two weeks from November 14. A novelty which attracts considerable attention is an automobile propelled by liquid air. The machine is practically a locomobile carriage with liquid air storage cylinders substituted for the boiler and water and naphtha tanks of the locomobile. There are several new types of steam engines designed for automobile work; one of these is a vertical two-cylinder engine, not unlike those used in the locomobile, in which a rotary valve operated by bevel gearing on the crank shaft replaces the link motion of the latter engine. There is also shown a two-cylinder rotary engine with a valve gear and reversing motion of extreme simplicity. Another exhibit that attracts considerable attention is that of the E. R. Thomas Motor Company, Buffalo, N. Y., which includes a particularly handsome motor bicycle known as the Auto-Bi. This machine conforms without any variation in its general outline to the standard bicycle. A 1½ horse power motor and tank are carried within the diamond frame, and power is transmitted to the rear wheel by means of a leather belt. The weight of this bicycle, which is beautifully finished, is 75 pounds complete.

The heavy loads which are imposed upon the axle bearings of the automobiles renders the ball bearing unequal to the service required, except in the case of the lighter machines. The best results are obtained with bearings of the roller type. One of the most successful of these, which has been doing good work in the cab service of New York city, is made by the American Roller Bearing Company. It is a straight bearing with an end-adjustment but no diametric adjustment. The bearing consists of a set of main rollers to sustain the weight running in races in the hub and on the axle. These main rollers are separated and guided by intermediate smaller rollers, which carry no weight and act as separators merely. The whole bearing is assembled in such a way that the parallelism of the main rollers is carefully preserved. We were shown a roller which, after one and a half years in electrical cab service, failed to show any wear that could be detected by the micrometer gage.

The Woods Motor Vehicle Company and the Waverley Factory exhibited pleasing designs of their several electric vehicles embodying improved features of motor construction.

Sawdust as Fuel in Austria.

Consul Hughes, of Coburg, says that in Austria, where everything in the shape of fuel is being carefully investigated, sawdust is impregnated with a mixture of tarry substances and heated to the proper temperature; it is then passed over a plate of iron heated by steam, from which a screw conveyor takes it to a press, where it is compressed into briquettes of the required size. The press turns out nineteen per minute, weighing two-fifths of a pound each, and measuring 6 by 2½ by 1½ inches. The caloric power is about the same as that of lignite, with but 4 per cent of ash. One factory produced last year over 7,000,000 briquettes, costing about 16 cents per thousand, and selling at from 95 cents to $1.

The Current Supplement.

The current SUPPLEMENT, No. 1299, is of unusual interest and variety. "The Section of Agriculture and Alimentation, Paris Exposition," is described and illustrated. "The Eucalyptus" is by Nicolas Pike. "Physical Growth in a Child" is an interesting anthropological article. "Sven Hedin's Travels in Thibet" is by H. K. Geissel. "A Scottish National Antarctic Expedition" is fully described. "Symbolic Rocks of Newbury and Byfield, Mass.," is by Horace C. Hovey, and is illustrated by eight engravings. "Pan-American Exposition Notes" are published for the first time. These will be published in nearly every number. "How Crucibles are Made" is an interesting technical article.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

STRAW-STACKER. — Conrad Glaum, Audubon, Minn. The straw-stacker can be used in connection with any thrashing-machine, the straw being distributed so that a perfect stack can be readily built up. The stacker is so constructed that its entire body or trunk, including the delivery-spout, may be vertically adjusted without interfering with the blower or fan, and so that the delivery-spout may be horizontally adjusted independently of the vertical adjustment of the body or trunk of the machine.

Miscellaneous Inventions.

DISH-WASHER.—Franklin S. Hogg, Manhattan, New York city. The invention provides a device by means of which a dish may be securely held, turned in any direction, and every portion of its surface thoroughly cleaned without bringing the hand in contact with the dish or with the swab used for cleaning. The device comprises a clamping-section, a cleaning-section, and a connecting-section, all of which sections are adjustably and universally connected.

SASH-PULLEY.—John Duffy, Grand Rapids, Mich. The novel feature of the invention is a pulley-casing provided with side flanges and overlapping portions. One overlapping portion has an opening and the other a tongue. On the other end of the casing there is also a tongue. Both tongues are to be bent out into engagement with the end walls of the mortise after the casing has been inserted in the mortise. It is, therefore, evident that the pulley casing is easily placed in position.

NEWSPAPER OR LETTER-FILE. — Henry P. Krehbiel, Canton, Ohio. On a base, file or impaling studs are mounted, together with rotatable posts each having a lateral arm and arranged opposite the studs. On each of the posts a clamping-block is adjustable and arranged to engage the post. When the papers have been impaled on the studs, they are secured by sliding the blocks upwardly and turning the posts so that their upper free ends are located above the studs.

TRUSS.—Joseph Fandrey, Los Angeles, Cal. A pad is employed provided with a projected portion between the ends. The projected portion has an approximately horizontal lower wall which extends diagonally of the pad. The portion below the projected portion has a curved or dished upper face.

COMBINED PENCIL-HOLDER OR PROTECTOR AND LETTER-BALANCE.—Otto Beckmann, Mannheim, Germany. The inventor has combined a pencil-holder or protector with a letter-balance in such a manner that the exterior appearance of the former is not materially altered. The device is especially convenient for travelers who often find difficulty in ascertaining the weight of their letters.

CANDLE-HOLDER.—Martin Hagen, Cashton, Wis. That Christmas trees are easily set on fire when a candle has burnt down to the last has been only too fatally proven time and time again. Mr. Hagen, in order to prevent this danger of fire, provides an improved candle-holder and automatic extinguisher. From the holder a vertical guide extends, which supports an angular plate resting on the candle, and a reflector. As the candle burns away, the plate descends, carrying with it the reflector. When the candle has all been burnt, the reflector is caused to drop upon the wick so that the flame is extinguished. The action is entirely automatic.

INK-PAD STAND.—Edward G. Woody, Wilmington, N. C. The object of the invention is to provide a new ink-pad or casing for removably holding an ink-pad and preventing dust from settling on the pad, thus insuring at all times a good inking of the stamp. The pad is received by a casing having an inclined, self-closing cover adapted to swinging rearwardly upon pressure from the hand carrying the stamp. When the stamp has been inked and withdrawn from the box the cover closes.

GAS-BURNER.—Theodore E. Sinnberg, 54 Vicarage Road, Camberwell, London, England. The invention relates to atmospheric gas-burners used for incandescent lighting and has for its object to enable the gas supply and air supply to be regulated to each other so as to secure the best possible result in illumination. The invention also enables an ordinary luminous flame to be temporarily obtained without removing the atmospheric burner, should the incandescent mantle become unserviceable when a new one is not at hand.

DENTIFRICE-BOTTLE. — Carr-Lowrey Glass Company, Baltimore, Md. Dentifrice bottles have usually a glass body, a metal cap, and a cork-stopper. The metal is so easily corroded and tarnished, that the goods cannot be sold when kept in stock for a considerable time. Labels usually cover and conceal the cork. Sometimes bayonet-joint stoppers are employed, as well as valved plugs. The present invention improves upon all these forms and marks a new stage in the manufacture of dentifrice bottles. The stopper is screwed in the neck. In a discharge-opening in the stopper a plug or valve fits, which is locked in place by means of a groove and a coacting lug. The construction of the bottle is such that material is saved, that the parts cannot corrode and can be readily removed and replaced.

Designs.

BOX-BLANK.—Carl Engberg, St. Joseph, Mich. The design in its entirety consists of center piece, having rounded corners and side flanges, extending from the sides of the center piece and having at their ends somewhat inwardly-deflected end flaps. Each flange has narrow flaps on its outer side, reaching onto the end flaps. The ends of the center piece have end flanges, extending between opposite end flanges and projecting somewhat beyond them.

FURNITURE-BUFFER.—Siegmund Salomon, Manhattan, New York city. The buffer has a circular body portion, at one side of which is a central semispherical projection; and extended from the edge at the opposite side are tooth-like structures.

Note.—Copies of any of these patents can be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Book "Dies and Diemaking," $1, postpaid. J. L. Lucas, Bridgeport, Ct. Send for index sheet.

Inventions developed and perfected. Designing and machine work. Garvin Machine Co., 141 Varick St., N. Y.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

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Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(7991) H. S. asks: How is the carrying capacity of German silver wire calculated? A. The carrying capacity of German silver wire can be calculated if its composition is known, but the variations from the theory will be so great in any practical case that it is better to determine carrying capacity experimentally, that is, find what size of wire will carry the current without overheating. The factors for the calculation of carrying capacity are the specific heat, the temperature coefficient, the emissivity, and the specific resistance. The specific heat of German silver of copper 60 parts, zinc 14 parts, and nickel 26 parts, is 0·097, that of copper is 0·093. Hence to heat the German silver wire as much as the same size of copper wire will require $\frac{93}{97}$ as much current. But the temperature coefficient of German silver is 0·1: hence ten times as much current will be required to heat a wire of German silver as would be required to heat one of the same size of copper. The specific resistance of German silver is 13, as compared with copper. Hence the heat of the German silver wire will be generated in a wire of $\frac{1}{13}$ the length and surface as that of a copper wire of the same size. Hence the emissivity of the German silver wire is involved. We are not able to find any data of the radiating power of German silver as compared with copper. If you have this factor, use it as above and the carrying capacity will be the product of the several factors multiplied by the carrying capacity of copper wire.

(7992) A. E. C. asks how to make spark coil that in connection with two or three cells of dry cell battery will give spark large enough to light a gas jet? A. For the dimensions of a spark coil, see Scientific American, vol. lxxxii, No. 26, answer 7905, price ten cents.

NEW BOOKS, ETC.

Up-to-Date Air-Brake Catechism. By Robert H. Blackall. Twelfth Edition, Revised and Enlarged. New York: Norman W. Henley & Company. 1900. 12mo. Pp. 254. Price $1.50.

The subject is a most important one, and railway men cannot be too well posted on the latest developments in air-brake practice. The present volume is now in its twelfth edition, which is sufficient guarantee of the excellence of the work. The question and answer style which has become so popular among railway men is retained. The diagrams are particularly clear.

The Electro-Magnet. Edited by Townsend Wolcott. Jersey City: Varley Duplex Magnet Company. 16mo. Pp. 60.

The author develops the electro-magnet along a new line which, on the whole, is rather interesting. Specific instructions are given for designing magnets of various sizes. Various formulas are also given.

INDEX OF INVENTIONS

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NOVEMBER 13, 1900,

AND EACH BEARING THAT DATE.

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Elevator boot, C. W. Levalley 661,879
Elevator brake, O. F. Burton 661,754
Elevator ram, hydraulic, R. T. Crane 661,576
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Engine. See Oil engine. Rock drill engine. Rock drilling engine. Rotary engine.
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Feed water heater, A. G. Hohenstein 661,932
Feed water regulator, I. H. Davis 661,853, 661,906
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Furnace, Laughlin & Reuleaux (reissue) 11,869
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Furnace construction, M. M. Suppes 661,564
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Harvester, grain, M. O'Connell 661,890
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Milk cooler, C. Huntsman 661,762
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Molding machine, W. Zoeller 661,571
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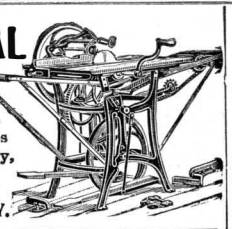

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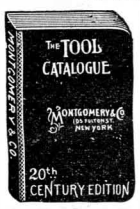

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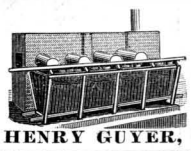

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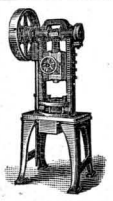

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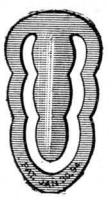

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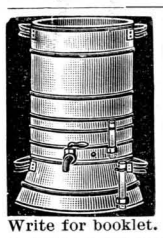

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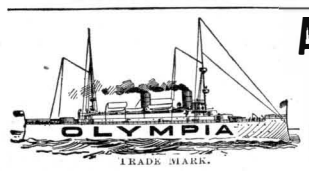

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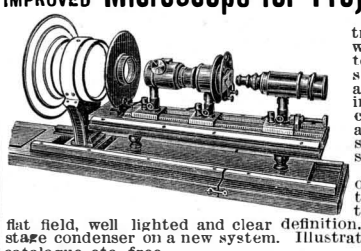

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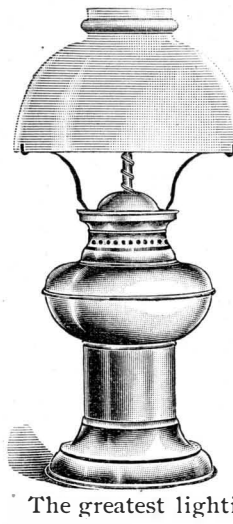

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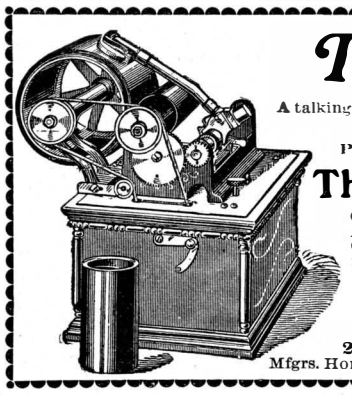

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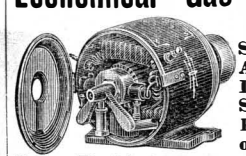

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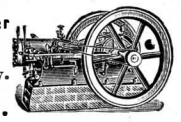

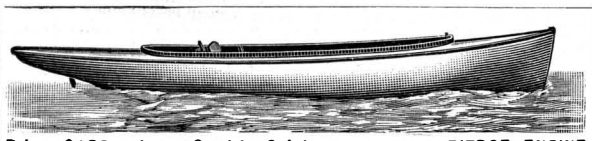

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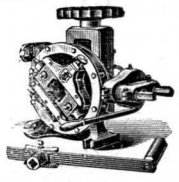

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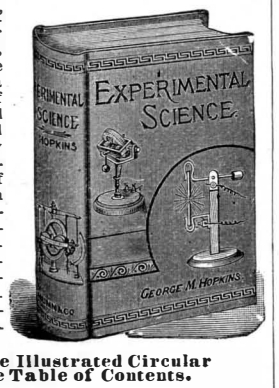

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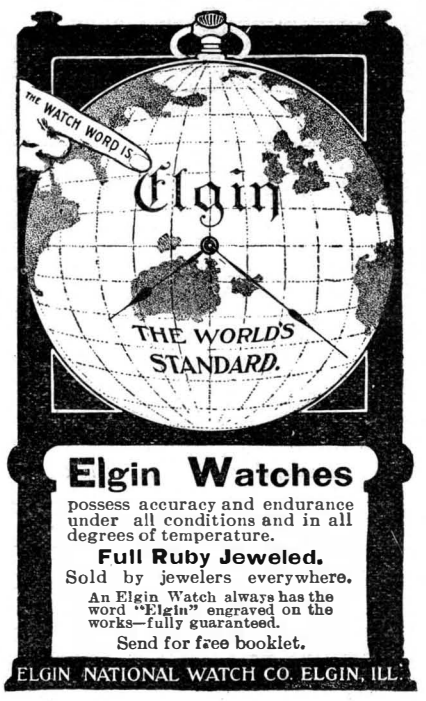

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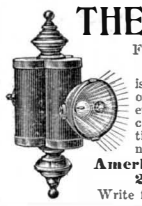

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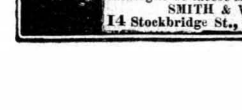

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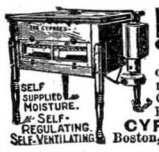

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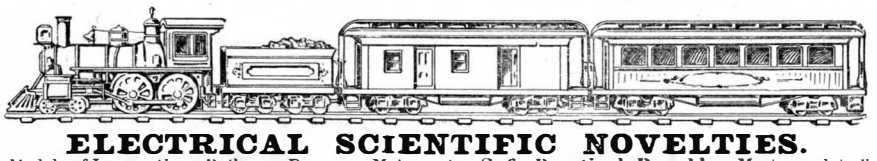

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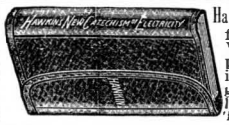

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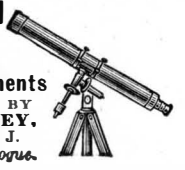

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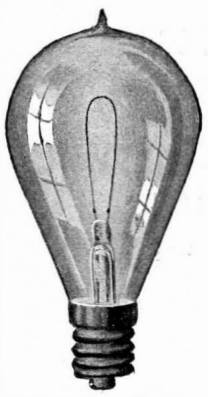

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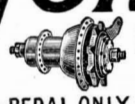

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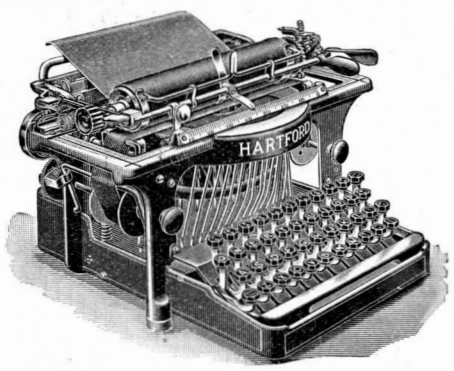

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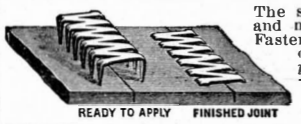

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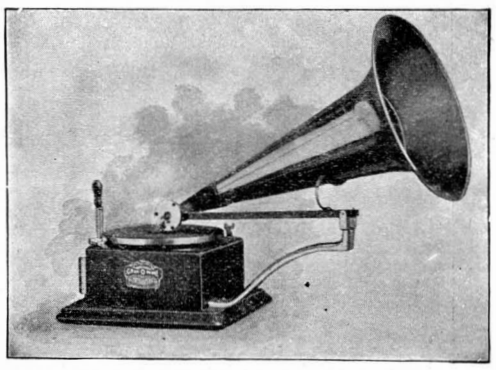

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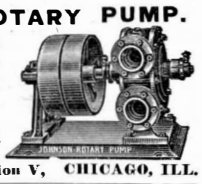

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